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FOREIGN MILITARY REVIEW

No 3, March 1988

Some Aspects of Military Intelligence and Counterintelligence (in the Views of U.S. and NATO Specialists)

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No 3, Mar 88 (signed to press 5 Mar 88) pp 9-14

[Article by Col A. Tsvetkov, doctor of military sciences, professor]

[Text] The West has always reserved a special role for its intelligence and special services in the struggle with socialism. Efforts are presently shifting in the direction of subverting certain measures for restructuring our economy and the system for controlling the national economy. Numerous intelligence and special services of the NATO countries have been given these objectives. The USA, as an example, has created an "intelligence community" to coordinate their activities: the CIA, the Defense Department's intelligence directorate together with the intelligence services of the armed services subordinated to it, the Defense Department's National Security Administration, the FBI and the intelligence services of certain departments (state, energy, treasury). Many other departments and administrations are also used in the interests of intelligence. But as in former times, the armed forces of the probable enemy remain one of the principal objects of intelligence. This article examines predominantly this aspect of the activities of the intelligence and special services of NATO countries.

Foreign military experts believe that armed struggle has always been, and will continue to be, associated with the need for obtaining accurate and timely information on the enemy (his capabilities, intentions and actions), terrain, weather and other factors which, if ignored, would make successful leadership of troop combat activities unimaginable. Acquisition of such information has been a special area of troop activities—intelligence.

The significance of intelligence has grown to an extreme in modern conditions, in which the striking power and mobility of the troops have risen dramatically, and their actions now encompass enormous areas. Effective use of nuclear and high precision weapons as well as other modern resources of armed conflict depends entirely on availability of accurate data on enemy installations, despite the great destructive power of such weapons. It is no accident that such persistent attention is devoted to intelligence in the armies of the principal capitalist states. Abroad, these issues have been the subject of a number of major works ("Tactical Intelligence in Modern Warfare," "Risk—The Key to Troop Reconnaissance," "War of the Minds," "Intelligence and Counterintelligence, Their Unity and Contrast" etc.) as well as many sections of manuals, regulations and other official guidelines.

The greater significance of intelligence has necessitated further development of its resources and improvement of its methods. It would be sufficient to say that owing to successes in electronics and automation, real possibilities have now been created for conducting reconnaissance in any area of the globe with the appropriate resources both beyond the zone of the enemy's activities and within his territory. This is most characteristic of the espionage activities of the USA, which maintains a tremendous intelligence staff and possesses modern reconnaissance resources.

Reconnaissance measures are organized in accordance with a foreign intelligence program (administered by the central intelligence director) and a tactical reconnaissance program (in the Defense Department). In addition the unified and special commands are developing a reconnaissance program for theaters of military operations, in accordance with which intelligence resources and organs are being deployed in zones of "vital importance" to the USA. Efforts are also being made to increase the capabilities of reconnaissance support to allied NATO troop groupings and exchanging intelligence, the bulk of which is accumulated in the staffs at the operational level (see figure). A combined automated system for collecting and processing intelligence is to be created in the future. The USA and NATO commands base their actions on the idea that the probable enemy will possess all of the modern weapons, and it is toward them that they are targeting their numerous intelligence forces. Special requirements are imposed on revealing the locations and quantities of nuclear and high precision weapons. In the opinion of foreign military specialists reconnaissance of these resources should be organized and conducted in such a way as to reveal them

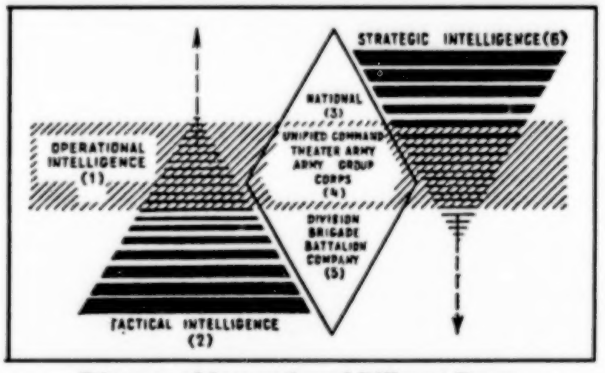

Diagram of Interaction of Different Forms of Intelligence

Key:
1. Operational intelligence
2. Tactical intelligence
3. NATO national intelligence
4. Command intelligence: unified, army group and army corps
5. Division, brigade, battalion and company intelligence
6. Strategic intelligence

prior to their activation, to determine the coordinates of the launch (fire) positions of launchers with a high degree of accuracy, and to establish other information with the greatest possible completeness. Radio, radiotechnical, eletro-optical, thermal and magnetometric reconnaissance resources are believed to be the most widespread and effective today. Their relative importance in the armed forces of the principal capitalist states is continually increasing. We can easily persuade ourselves of this by briefly examining the status and prospects for development of military equipment.

Space reconnaissance resources installed aboard satellites and spacecraft carry a rather intricate complex of radio, radiotechnical and photographic apparatus capable of documenting the work of the enemy's technical resources from near-earth orbit—that is, outside the range of antimissile (antiaircraft) resources—and of establishing the locations of installations and their nature with high resolution. For example the electro-optical systems installed aboard KH-11 and LANDSAT spacecraft can conduct surveillance in specific zones of the spectrum, distinguish objects on the ground relatively easily, reveal camouflaged targets and so on.

Plans for the future call for raising the maneuverability of reconnaissance satellites, using special apparatus to protect them and furnishing them with systems that can fire on the enemy's objects in space. Another goal is to improve the system for transmitting information from reconnaissance satellites to ground information collection points, down as far as army corps command posts.

The possibilities of equipment carried by airplanes have risen significantly in connection with the appearance and development of new types of manned airplanes and numerous unmanned resources. Manned and unmanned reconnaissance airplanes being supplied to the units are now being furnished with the most sophisticated models of radar, thermal, television, magnetometric and photographic apparatus as well as automated devices to transmit information to information collecting points. These airplanes can remain in the air for a long period of time, flying at all altitudes (from the lowest to the highest) and in adverse weather.

Measures to conduct air reconnaissance by resources that remain over friendly territory are expanding. Thus the NATO command has organized constant peacetime surveillance of installations in Warsaw Pact countries by means of E-3A AWACS aircraft, the TR-1 and many other aircraft. It was reported for example that the reconnaissance capabilities of American troops in the European theater of war were significantly increased by deployment of the ASARS-2 system (improved radar with a synthetic aperture installed aboard TR-1 airplanes).

Successes attained in using reconnaissance drones servicing ground troop formations directly have been noted in the foreign press. Being smaller than manned aircraft, they possess significantly greater capabilities for covert reconnaissance, they can operate near the forward edge, and they can be launched as needed and at the discretion of the formation commander. Because they carry modern aerial cameras, infrared and radar surveillance resources and television equipment, they can transmit intelligence directly to a command post. According to reports in the foreign press several models of such drones with a maximum range of up to 400 km flying at altitudes up to 16 km have been developed (the American Aquilla, the English Phoenix, the Canadian CL-289 etc.).

Saturation by modern technical resources is also typical of ground reconnaissance. For example the American AN/PPS-5 short-range portable radar set can detect a person at a range of 5 km and a tank at 10 km, while the Israeli EL/M-2121 long-range radar set (vehicle-mounted) can do so at 20 and 40 km respectively. Ground reconnaissance subunits possess rather effective optoelectronic instruments by which to observe the enemy and photograph his installations not only during the day but also at night as well as in limited visibility. Thermal reconnaissance apparatus is presently enjoying increasingly wider use.

The foreign press writes a great deal about so-called "deep destruction" of the enemy, about cutting off or preventing the approach of his second echelons (reserves) to the forward edge. It is emphasized that success can be counted on only if meticulous and comprehensive reconnaissance support is provided to resources participating in an operation (combat). It is therefore no accident that Western specialists are attempting to bring them together into reconnaissance-strike complexes capable of determining the exact coordinates of enemy installations and striking them in short time.

It is believed that the new observation resources and various sensors allowing the command and staff to constantly have information on the enemy available may play a large role in the air-land operation (battle). The command and control system supporting such an operation should be able to generalize the information coming from different sources and transmit it to the formations and units in real time simultaneously with information on revealed targets. Foreign military specialists note that the value of technical reconnaissance resources increased dramatically in recent years. Exercises and calculations show that up to 85 percent of all information on the enemy is acquired by them.

Creation of ground intelligence reception points (the GSTARS ground target reconnaissance and weapon guidance system) and a unified system for processing and distributing intelligence acquired by ground troops and the air force is foreseen in connection with the "air-land operation (battle)" concept. It is anticipated

that this will allow tactical-level commands and staffs to collect and process information on the enemy and target his second echelon (reserve) forces in short time.

It is noted in the foreign press that clandestine intelligence, carried on by specially trained persons sent into the enemy rear, occupies an important place in the overall intelligence system. It is believed that it is the most reliable means of revealing the disposition areas of missiles, aviation, control posts and other important objectives and of maintaining surveillance on them. Improvements in it abroad are presently proceeding along two basic directions: creating an agent net in the enemy disposition and including intelligence agents in the composition of reconnaissance and sabotage groups.

Foreign armies devote significant attention to dropping groups and detachments of various sizes (5-8 and 60-80 men) from special-purpose troops deep into the enemy rear. They are equipped with portable technical reconnaissance equipment—electro-optical observation devices, including laser range finders, and radio and radiotechnical reconnaissance resources. The groups are supplied with explosives, rocket launchers and even small nuclear mines for sabotage activities at enemy installations.

Besides saturating the troops with new military equipment, the NATO command is attaching great significance to improving the activities of intelligence forces. It is emphasized in official regulations that reconnaissance must be conducted with exceptional aggressiveness, continuously, to considerable depth both in the enemy's disposition and in the intervals, at the flanks and in the rear of friendly troops. Concurrently the admission is made that reconnaissance information is not always going to be exhaustive and timely. However, commanders are obligated to adopt their plans and organize an operation (battle) despite the absence of some information on the enemy. Therefore, it is no accident that emphasis is laid on the need for acquiring, processing and disseminating information continuously in peacetime and in wartime.

Even prior to the beginning military operations, NATO's intelligence services are trying to obtain a significant volume of information from the press and from other overt sources; they are also utilizing covert channels for this as well. NATO staffs receive the bulk of their reconnaissance information from national special services of the bloc countries. All information on the probable enemy is accumulated and published in special handbooks intended for permanent use. Information that changes relatively quickly is acquired and updated prior to the beginning of military operations.

The foreign press emphasizes that in a theater of military operations, NATO staffs must possess sufficiently reliable information on the opposing troop grouping, its composition, its combat capabilities, its vulnerable points and the probable nature of its actions, and on the theater of military operations and the local population. The tasks of providing and accumulating such information are within the responsibilities of the deputy chief of staff for intelligence. He is responsible for forming intelligence (for collecting and processing information and transforming it into intelligence), conducting counterintelligence and organizing reconnaissance training for subunits.

To accomplish these tasks, the staff maintains a constant estimate of the situation, formulates missions for reconnaissance forces and resources, requisitions information from other sources, organizes coordination of all forms of reconnaissance conducted by the formations (units), and records, accumulates, generalizes, analyzes and evaluates information coming from all reconnaissance organs and units (ground, air, electronic, clandestine etc.), from interrogation of prisoners and detained civilians, and from captured documents and materiel. The staff also implements other measures; for example it draws up recommendations on reconnaissance for artillery, engineer and other units (subunits).

Much significance is attached in foreign armies to automating collection and processing of information by staffs using computers, which makes it possible to drastically reduce the time from the moment a target is detected to the commander's adoption of a decision to employ his weapons. Displays that can be used to document additional data on the enemy that are not plotted on a map will be present at division and corps command posts. These data will usually be presented in the form of tables summarizing the enemy's resources. It is emphasized that a display that provides obsolete information can mislead the command.

Foreign specialists feel that the greater significance of reconnaissance as a most important measure ensuring successful use of all of the latest weapons compels each of the belligerents to make a persistent effort to interfere with the conduct of reconnaissance and to carry out active counterintelligence measures. In their opinion the effectiveness of the enemy's reconnaissance effort can be reduced significantly through competent activities directed at neutralizing or destroying his resources.

Now that use of nuclear, high precision and other weapons would be unimaginable without the presence of accurate and timely intelligence on installations (targets) against which strikes are planned, successful struggle against enemy reconnaissance may have a significant influence on the course of an operation or battle. It is directly stated in the foreign press that one of the active forms of such struggle will be counterintelligence. It is believed for example that in order to make it impossible for a significant part of the enemy's nuclear missile forces to carry out their assigned missions, it would be sufficient to paralyze just his technical reconnaissance resources alone.

Considering the possibilities of modern reconnaissance and the diversity of the resources it employs, successful struggle against it may be ensured only through competent organization and prompt implementation of a complex of the most diverse measures. These measures, which supplement and reinforce one another, are directed at preventing the enemy's use of reconnaissance resources by striking them (aggressive measures), by reducing their effectiveness through concealment of real installations and by making surveillance difficult (passive measures), and by misleading the enemy.

Active measures against enemy reconnaissance include revealing all forms of resources (their disposition, purpose, composition, methods of use, technical parameters, readiness etc.) and annihilating or neutralizing them. It is indicated in the foreign press that the most effective resources can be used for this purpose today. Thus it is recommended that the enemy's reconnaissance satellites can be destroyed by the ASAT antisatellite weapon system and, in the future, by maneuvering and stationary antimissile platforms equipped with laser weapons. The enemy's air reconnaissance resources can be fought with antiaircraft guided missiles and fighter aviation. It is recommended in this case that the fight against the enemy's aerospace reconnaissance resources should be organized within a general antimissile (antiaircraft) system, and that this should be treated as one of the most important missions of commands and staffs in any situation.

Ground reconnaissance installations are to be destroyed by artillery, aviation and high precision weapons. Artillery may become the most massive and effective resource. Its range of fire permits effective fire against radar stations, observation posts and so on. Such targets are usually neutralized by short but powerful artillery strikes alternating with battery fire. Installations located far from the front line are destroyed by aviation and, in areas protected by strong air cover, by missiles.

Destruction of reconnaissance resources by nuclear weapons will usually be combined with strikes against other installations. Nuclear weapons may be utilized directly against group installations consisting of several important targets or when such installations have strategic or operational-tactical significance (airfields used as bases for reconnaissance aviation, the locations of large reconnaissance and sabotage formations).

In recent years, the foreign press notes, besides improving the conventional methods of destroying technical reconnaissance resources, much attention is devoted to employing homing drones and missiles capable of automatically finding a particular operating station or group of stations belonging to the enemy and striking them.

In cases where there is not enough information on enemy reconnaissance resources to permit a fire strike against them or when it is disadvantageous or impossible to annihilate such installations by fire strikes, special-purpose troop subunits are believed to be a suitable means of combating the most important of such installations.

Jamming technical resources is believed to be an extremely effective means of combatting enemy intelligence today. Jamming has the advantage that it can be employed even when the location of enemy reconnaissance resources is not precisely known.

Major significance is attached today to organizing the fight against ground reconnaissance units and subunits attempting to penetrate to the most important military objectives and establish their nature and exact coordinates. Dependable security capable of effectively foiling the enemy's intentions and keeping his units from penetrating to such installations plays the main role in this fight. Wide use is to be made of various technical resources (radar and television apparatus, automatic warning systems and other devices) to organize security of installations, especially ones with low mobility (launch positions, missiles, airfields etc.).

In addition the opinion is stated that commanders of all ranks should have access to small but sufficiently strong, highly mobile, constantly combat ready subunits to destroy enemy reconnaissance groups and detachments infiltrating across the front line (landed in the rear).

In the opinion of foreign military specialists enemy agents can be liquidated by the joint efforts of well organized counterintelligence and security services. The most important missions of these organs are to reveal and arrest suspicious persons, investigate cases of sabotage and espionage, check the loyalty of the population in the forward edge of the battle area, and so on. In order to ensure the success of the fight against the enemy's agents and reconnaissance groups, formations and major formations of the American army conducting combat activities are to be reinforced with military intelligence (counterintelligence) units (subunits) of the ground troop intelligence and security command, allocated at a rate of approximately one detachment per division and a battalion per army corps (major formation).

Other measures can also be implemented against enemy reconnaissance: reinforcing the commandant's service, combing the civilian population, and moving the population out of the disposition areas of troops, large staffs and other important objectives.

Besides active measures, passive measures having the purpose not of destroying the enemy's reconnaissance resources but hindering their activities or reducing their effectiveness are now receiving significant attention abroad. Among them, foreign military specialists include camouflaging troops and the most important installations, maintaining the high vigilance of the personnel, complying strictly with the rules of covert troop command and control, maintaining established order in

troop disposition areas, limiting the movements of personnel and transportation, reducing the time of work of communications hardware and so on.

Camouflage is the most important of these measures. As we know, its' objectives are to conceal (eliminate) the revealing signs of installations or troop activities. Measures in this area are divided into two groups: The first includes the use of the natural concealment properties of the terrain and the time of the year and day, while the second includes the use of artificial screens of various types (concealing, shielding and jamming).

Use of the natural concealment properties of terrain has the goal of concealing installations not so much from visual enemy observation as from reconnaissance by means of various technical resources. It is believed that it is best to locate installations in forests, brush, gullies, excavations and mines, and behind fill, which would significantly hinder their detection.

Significantly more attention is being devoted today than in the past to protecting installations by means of stock concealing screens (frames, coverings etc.). For example the foreign press contains a number of recommendations on employing screens that are highly effective in sheltering equipment and weapons against the enemy's reconnaissance by radar, thermal range finders and infrared devices. It is believed that concealing effects can be augmented by using special fabrics, two-sided painting of the surfaces of stock resources, breaking up the contours of screens, imparting curved outlines to them, and employing special dyes that reflect infrared rays in the same manner as the surrounding terrain. Individual shape-altering screens for equipment and armament that can be deployed in several seconds are believed to be extremely promising in the opinion of foreign specialists.

Shielding screens capable of not only concealing an object but also scattering electromagnetic waves, weakening their power, and consequently hindering identification of the nature of the object, are believed to be a rather effective resource. They are significantly supplemented by so-called jamming screens.

Measures to mislead the enemy, which many Western specialists also ascribe to counterintelligence activities, occupy a special place in the system of the struggle against enemy intelligence. Besides creating dummy installations (targets) and conducting troop feints and misleading actions by reconnaissance, conducting extensive deception through radio messages, instructions via communication hardware and battle documents is recommended. In this case, foreign authors write, an effort should be made to keep the deceptive measures from being revealed by any reconnaissance resources. It is emphasized that if the enemy discovers an attempt to mislead him, this may result in unfavorable consequences, since it would attract attention to the real plan. Sometimes it may be advantageous to consciously but thoughtfully "reveal" the code of coded documents, communication passwords, call signs and other data so as to allow the enemy to "take advantage of this favorable possibility." Judging from publications in the foreign press, drawing up false battle documents (operation orders, instructions, plans etc.) that are transmitted to executors who are unaware of their real significance is a deception technique that justified itself in past wars and may enjoy wide use.

In all cases it is recommended that measures to deceive the enemy be kept in strictest secrecy, and that at the same time the corresponding measures should be implemented in such a way that deceptive actions would not cause uninformed commanders of friendly troops to make the wrong tactical decisions.

As we can see from the above, intelligence and counterintelligence have become an inseparable part of troop combat activities, and they are concerned with an extremely wide range of issues. It is believed that they should be based on integrated use of the most diverse resources capable of revealing the most important enemy objectives and the efforts of his reconnaissance forces in short order, and then destroying (suppressing) or neutralizing their actions, depriving them of the possibility for acquiring information needed to support weapon use, especially use of nuclear and high precision weapons, and thus creating more favorable conditions for friendly troops to carry out their combat missions.

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Turkish Ground Troops

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[Article by Col V. Bobrov]

[Text] The military-political leadership of Turkey—a member of the North Atlantic Treaty Organization—devotes great attention to improving its armed forces. The command of NATO combined armed forces has an important role for them to play in maintaining control over the Black Sea straits. Increasing the fire and striking power of the ground troops (their emblem is shown in Figure 1 [not reproduced]) occupies the main place in the plans for reorganizing and modernizing the armed forces.

Structure

The ground troops are the most numerous armed service (542,000 men, of whom 497,000 are in their first term of service), and they are intended for military activities jointly with the air force and navy as well as within the composition of NATO combined armed forces in the South European theater of war employing conventional

and nuclear weapons. They include practically all branches of troops—armored, infantry (motorized infantry), artillery, army aviation, engineer troops, signal troops, special purpose troops, and services—transportation, artillery- technical, repair and restoration, medical, financial and others.

The armored troops—the main strike force of the ground troops—are best adapted to offensive operations involving the use of nuclear weapons. They are represented by an armored division (training), separate armored brigades and regiments, and tank and reconnaissance battalions and companies.

Infantry (motorized infantry) is intended for combat operations within the composition of infantry and mechanized divisions, separate brigades, regiments and battalions with the purpose of destroying the enemy and seizing and holding individual areas of ground or objectives.

Artillery includes units and subunits organizationally a part of combined-arms formations, artillery commands of field armies and artillery regiments at corps level. It is intended to accomplish fire missions in all forms of battle and operations in the interests of other branches of troops. It includes tube artillery and mortars, antitank guided missiles, troop Air Defense weapons and artillery reconnaissance subunits.

Army aviation is represented by army air regiments and battalions subordinated to armies and corps.

Engineering troops are intended to provide engineering support to the combat operations of formations and units. They contain engineering regiments and battalions and separate units and subunits created for different purposes.

Signal troops (communication regiments and battalions) organize communications and support troop command and control.

Special-purpose troops are intended to conduct reconnaissance and sabotage operations and to carry out psychological operations and other disruptive activities. They include a separate airborne brigade, separate commando brigades and psychological warfare subunits.

According to the foreign press the ground troops possess 18 divisions—14 infantry (infantry as well as type A and B infantry divisions; the latter are sometimes called motorized infantry divisions), 2 mechanized divisions, an infantry training division and an armored training division; 24 separate brigades (6 armored, 4 mechanized, 11 infantry, 1 airborne and 2 commando), and combat and rear support units and subunits.

All of the formations are brought together into four field armies and two separate army corps (Figure 2). In addition there are a ground troop training command, two internal zone commands and logistical support subunits. Around 30 artillery battalions equipped with 203.2-mm howitzers, 175-mm self-propelled guns and 155-mm howitzers, up to 20 antiaircraft artillery battalions, 3 engineering regiments, 20 engineering battalions, 3 army air regiments and around 10 army air battalions, 3 communication regiments and 12 communication battalions, and rear support subunits are directly subordinated to field army commanders and army corps commanders.

Overall operational leadership of the ground troops is exercised by the commander (an army general), who is appointed for a 2 year term by the council of ministers at the proposal of the chief of general staff and the defense minister, and approved by the country's president. He is directly subordinated to the chief of general staff, and he is responsible for development of the ground troops, their manning, their combat training and logistical support. The commander exercises leadership over major formations, formations and units through the staff (in the city of Ankara), headed by the chief of staff (a corps general). The chief of staff is the first deputy commander of the ground troops. He manages the staff directorates, he is responsible for the combat readiness of the ground troops, for planning and calculation of combat resources, for determining the budget, for selecting and purchasing weapons and military equipment and for the combat and operational training of large strategic units, formations and units, and he organizes coordination with air force and naval staffs and with ministries and civilian departments.

The ground troop formations and units are armed with (including equipment stored at depots) over 3,700 tanks (77 Leopard-1A3, 1,615 M48A5, 1,085 M48A1, Figure 3 [not reproduced], 900 M47, Figure 4 [not reproduced], 100 M41), 3,750 M113 armored personnel carriers (Figure 5 [not reproduced]) and M59, M2 and M3 armored personnel carriers, around 700 105-, 155- and 203.2-mm self-propelled howitzers and 175-mm self-propelled guns, over 2,000 75-, 105-, 155- and 203.2-mm howitzers, 1,800 mortars of different calibers (81, 106.7 and 120 mm), up to 2,500 recoilless guns (75 and 106 mm), 500 Cobra antitank guided rocket, SS- 11, TOW (Figure 6 [not reproduced]) and Milan launchers, around 1,500 20-, 35-, 40-, 75- and 90-mm antiaircraft guns, over 150 airplanes, around 250 army aviation helicopters of different types, and other combat equipment.

Organization

The largest major operational formation of the ground troops is the field army, the commander of which (an army general) is subordinated to the ground forces command and is fully responsible for the status of troops within its composition and for their combat readiness. The staff is the commander's operational organ for troop leadership (it includes the chief of staff, his two deputies and four departments—personnel, reconnaissance, operations and combat training, and rear services). Together

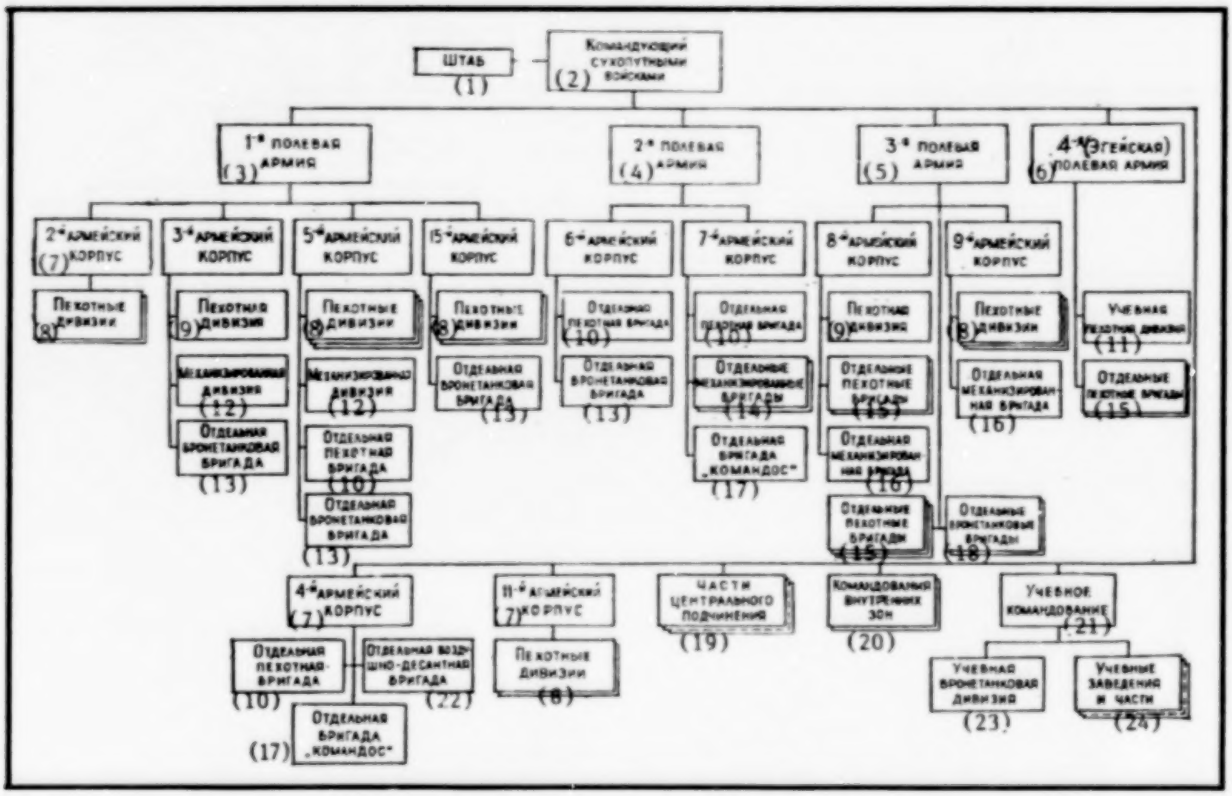

Figure 2. Organizational Structure of Turkish Ground Troops

Key:
1. Staff
2. Ground forces commander
3. 1st Field Army
4. 2d Field Army
5. 3d Field Army
6. 4th (Aegean) Field Army
7. Army corps
8. Infantry divisions
9. Infantry division
10. Detached infantry brigade
11. Infantry training division
12. Mechanized division
13. Detached armored brigade
14. Detached mechanized brigades
15. Detached infantry brigades
16. Detached mechanized brigade
17. Detached commando brigade
18. Detached armored brigades
19. Centrally subordinated units
20. Internal zone command
21. Training command
22. Detached airborne brigade
23. Armored training division
24. Training schools and units

with the departments and commands subordinated to them, the chiefs of the branches of troops and services are included within the composition of the army staff, in which they exercise the rights of department chiefs.

The highest tactical formation capable of operating independently is the **army corps,** and its principal tactical formation is the **division**. Turkish divisions have a regimental system of organization which, in the estimation of Western military specialists, is inferior to the organization of divisions maintained by NATO countries in Central Europe. However, it is believed that they are well adapted to combat operations in the South European theater of military operations.

An infantry division consists of a command and a staff, three infantry regiments (with three battalions each), one artillery regiment, three battalions (tank, combat engineer and communications), three companies (headquarters, reconnaissance, antitank guided rocket) and the division's rear services. It contains a total of around 13,000 personnel, over 60 tanks, up to 200 field artillery guns and mortars, and over 100 antitank weapons.

A type A infantry division contains two infantry and one armored regiment (two tank and one motorized infantry battalion). It is armed with around 120 tanks. All other components of a division of this type are the same as in an infantry division.

A type B infantry division is distinguished from a conventional division only in that one of the three regiments is a mechanized regiment (containing two motorized infantry and one tank battalion).

A mechanized division includes a command and a staff, three mechanized regiments (each containing two motorized infantry and one tank battalion), a self-propelled artillery regiment, an antiaircraft artillery battalion,

Личный состав и вооружение (1)	(2) Дивизия			
	Пехотная (3)	Пехотная типа А (4)	Пехотная типа В (5)	Механизированная (6)
Личный состав (7)	13 000	12 000	13 000	13 000
Танки (8)	60	120	60	200
Бронетранспортеры (9)	—	100	160	500
Орудия ПА и минометы (10)	200	150	190	160
75- и 106-мм безоткатные орудия (11)	70	60	80	90
ПУ ПТУР (12)	40	40	40	40
РПГ (13)	400	450	500	560

Number of Personnel and Quantity of Basic Armament in Divisions of the Turkish Ground Troops

Key:
1. Personnel and armament
2. Division
3. Infantry
4. Type A infantry
5. Type B infantry
6. Mechanized
7. Personnel
8. Tanks
9. Armored personnel carriers
10. Field artillery guns and mortars
11. 75- and 106-mm recoilless guns
12. Antitank guided missile launchers
13. Antitank missile launchers

three battalions (reconnaissance, combat engineer and communication), two companies (headquarters, antitank guided missile) and the division's rear services. It contains around 13,000 personnel, up to 200 tanks, almost 500 armored personnel carriers, over 150 field artillery guns and mortars, and more than 130 antitank weapons (the number of personnel and the quantity of basic armament in the divisions are shown in the table).

A separate infantry brigade has a command and a staff, four infantry battalions, two artillery battalions, an antiaircraft artillery battery, six companies (headquarters, reconnaissance, tank, antitank guided missile, combat engineer, communication) and brigade rear services. The brigade possesses a total of over 5,000 personnel, more than 25 tanks, around 90 field artillery guns and mortars, and up to 50 antitank weapons.

A separate armored brigade consists of a command and a staff, two tank and two motorized infantry battalions, two self-propelled artillery battalions, four companies (headquarters, reconnaissance, combat engineer, communication) and brigade rear services. It is armed with around 120 tanks, up to 70 self-propelled field artillery guns and mortars, and almost 40 antitank weapons. The personnel strength of a brigade is around 5,000 men.

The airborne brigade and the commando brigade each possess four battalions. The personnel strength of each is over 3,000 men.

Combat Use

In the estimation of foreign military specialists the Turkish ground troops possess limited capbilities for offensive operations. But in defense they are capable of holding and of defensive operations until the approach of allied troops. Together with formations and units of Greece and the USA, the ground troops are included in the composition of NATO combined ground forces in the southeastern part of the South European theater of military operations (the headquarters is in Izmir). This command's zone of responsibility includes the Balkan Peninsula and the Asiatic part of Turkey.

NATO military experts believe that the Bosporus-Dardanelles sector, delimited by the Greco-Turkish border, the west coast of Anatolia and the Black Sea coast make up the most important sector of operations in this area. The terrain within its bounds permits the use of practically all branches of troops. This sector of operations has great significance to the outcome of operations aimed at blockading the Black Sea straits. It is covered by troops of the 1st Field Army, the headquarters of which is in Istanbul. It contains the 2d, 3d, 5th and 15th army corps as well as combat and logistical support units and subunits. The 1st Field Army has a total of 10 divisions and 4 separate brigades. In the estimation of NATO military specialists the 1st Field Army is the best manned and most battleworthy.

NATO distinguishes two sectors of operations in the Asiatic portion of Turkey—Kars-Erzurum and Karakeci-Diyarbakir. Both extend to the border of the Soviet Union, and they are typified by complex topography. Four passages are the most accessible to troop operations—Chorokh [transliteration], Kelkit, Kars-Erzincan-Sivas and Karakeci-Mus-Elazig. These sectors of operations are covered by the 3d Field Army (headquartered in Erzincan), which consists of the 8th and 9th army corps (a total of four divisions and nine separate brigades).

The 2d Field Army (headquartered in Malatya) is intended to cover the southeastern borders of Turkey. It includes the 6th and 7th army corps (a total of six separate brigades).

The 4th (Aegean) Field Army (headquartered in Narlydere [transliteration]) was formed in 1975 to cover the defenses on the shores of the Aegean and Mediterranean seas. It contains a training infantry division and two separate infantry brigades.

The 4th Army Corps (headquartered in Ankara) is in Central Anatolia. It consists of three separate brigades and combat and logistical support subunits, and it is the reserve of the ground troop command.

The 11th Army Corps (headquartered in Kyrenia) has been located on the island of Cyprus since 1974 under the pretext of maintaining the security of the Turko-Cypriot community. It contains two infantry divisions with a total strength of over 23,000 men (the locations of Turkish ground troops are shown in Figure 7).

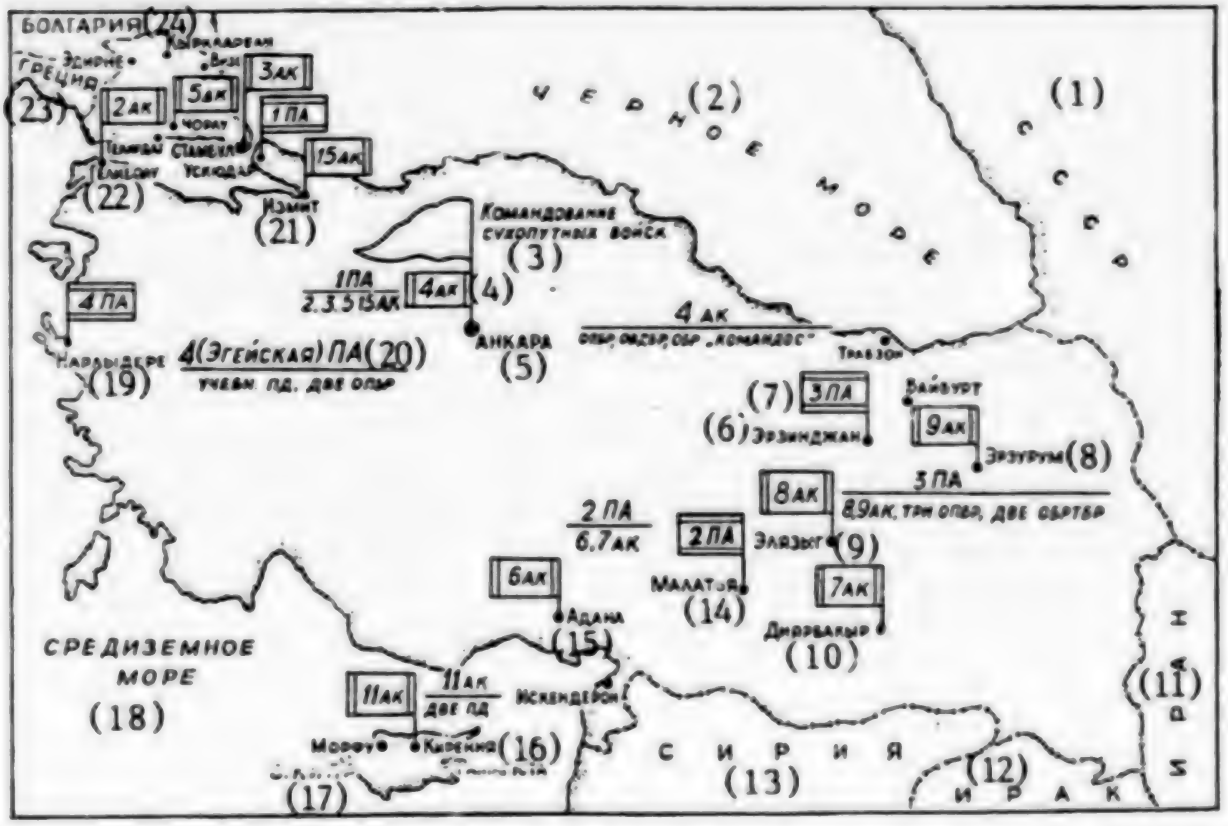

Figure 7. Locations of Turkish Ground Troops

Key:

1. USSR	2. Black Sea	3. Ground troop command	4. Army corps	5. Ankara	6. Erzincan
7. Field army	8. Erzurum	9. Elazig	10. Diyarbakir	11. Iran	12. Iraq
13. Syria	14. Malatya	15. Adana	16. Kyrenia	17. Cyprus	18. Mediterranean Sea
19. Narlydere	20. 4th (Aegean) Field Army	21. Izmit	22. Gelibolu	23. Greece	24. Bulgaria

Combat Training

The combat training of Turkish ground troops is tailored to missions in keeping with the basic requirements of the NATO command. This is why it goes on in close coordination with the overall operational-strategic plans of the bloc, under the guidance of its coalition commands in the South European theater of military operations. Annual joint exercises of ground troops with other Turkish armed services ("Sonbakhar" [transliteration]—"Winter") are the final phase of combat training. The main attention is devoted in these exercises to preparing the personnel for actions in rough mountain terrain in winter conditions, and for diversionary actions.

Organizational Development of Ground Forces

It is reported in the foreign press that the long-range plans for the organizational development of the ground troops, extending to the year 2000, foresee improving the

organizational structure of the formations and units, supplying them with modern weapons and combat equipment with the purpose of raising the mobility and the fire and striking power of the troops, and providing them with command and control and communication resources.

Renewing the tank park is first priority. M48 tanks are being modernized at a tank repair plant in Arifiya [transliteration] built with the assistance of West German specialists (gasoline engines are being replaced by diesel engines, 90-mm guns are being replaced by 105-mm guns, fire control instruments are being installed, etc.). There are plans for organizing production of infantry fighting vehicles, portable antitank guided missile launchers, MLRS multiple missile launcher systems, Erlikon 35-mm antiaircraft mounts and Stinger antiaircraft missile systems in Turkey with the assistance of NATO partners. In compliance with bilateral agreements the FRG is supplying Turkey with M48A2 and Leopard-1A3 tanks, Milan antitank guided missile launchers, motor vehicles, engineering equipment and communications apparatus. Deliveries of self-propelled artillery systems, M60 tanks, TOW antitank guided missile launchers, antiaircraft missile systems and other armament are awaited from the United States.

Foreign military specialists feel that after the program for modernizing the Turkish ground troops is completed, they will completely satisfy the requirements imposed by the military-political leadership of NATO.

Program for Training Servicemen for Long-Range Reconnaissance Subunits in the U.S. Infantry

18010337c Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian
No 3, Mar 88 (signed to press 5 Mar 88) pp 25-26

[Article by Lt Col I. Aleksandrov]

[Text] Among measures of the U.S. command directed at raising the combat capabilities of infantry, organizing and improving troop reconnaissance occupies a special place. American military specialists note that its significance has risen significantly in recent times. It is reported in the foreign press that since 1986, servicemen have been undergoing training for long-range reconnaissance subunits in special courses offered at the infantry infantry school in Fort Benning (Georgia). These subunits are to be formed in "heavy" and "light" divisions and in army corps in accordance with the new organizational structure, transition to which is currently proceeding within the framework of the "Army-90" infantry modernization program.

The role allocated to these subunits may be surmised from the fact that the American leadership is trying to man them with highly qualified specialists in sabotage and reconnaissance. Thus only male volunteers (officers and NCOs) are enrolled in the courses. They must have undergone airborne training or training in the Ranger program, they must be physically and mentally healthy, they cannot drink and use drugs, and they must use small arms well.

Instructors for the courses are selected from among officers and NCOs who had undergone training in this school's Ranger program. The study groups are formed in such a way that specialists in intelligence and communications would train in the same subunit, since it is believed that this is the best method of achieving interchangeability of personnel, and that effectiveness of actions in the enemy rear rises as a result.

The training program is 515 training hours long, and it includes the following disciplines.

Organization of long-range reconnaissance (8 hours). A study of the history, organization and missions of long-range reconnaissance (2) and of the features of controlling such a subunit (6).

Reconnaissance (82 hours). The topics covered include the methods of penetrating into the enemy rear and returning to the disposition of friendly troops (34), conducting reconnaissance by surveillance (3), movements (6), and actions taken in patrols (7), to capture enemy servicemen (2), in response to a surprise attack by the enemy (1), on unfamiliar terrain and to maintain survival (4). In addition 24 hours are devoted to planning reconnaissance management.

Communications (33 hours). The lessons cover the general procedures for working with communication resources (4), information transmission (2) and coding equipment (7.5), the AN/PRC-77 (4) and the AN/PRC-70, -74B and -104 radio sets (8), digital data transmission devices (4), the G-76 generator (0.5) and antenna systems (4).

Information on the enemy (22 hours). The students are acquainted with the tables of organization and structure of enemy subunits (2), with models of weapons and military equipment (16) and with their identifying signs (4).

Military topography (21 hours) includes study of aerial photography (2), work with maps (3) and individual day (8) and night (8) orienteering exercises.

Command-and-staff exercises (120 hours). Two exercises 48 and 72 hours long are conduced.

Field exercises (216 hours). Two exercises 72 and 144 hours long are organized on terrain with topography of varying complexity on which various simulated enemy installations are set up.

Examinations (13 hours). Acquired knowledge is tested by a general examination (4) and examinations in reconnaissance and security (2), topography (2), communications (1) and physical training (4), and swimming tests in full battle gear.

A condensed training program consisting of six 4-hour weekly exercises in places specially allocated for reserve training and 2-week training camps in Fort Benning was developed for servicemen in reserve components of the infantry (the National Guard and the Army Reserve) selected for service in long-range reconnaissance subunits.

In the opinion of American military specialists the existing organization for training personnel for long-range reconnaissance subunits is an important element in raising the capabilities of U.S. infantry for troop reconnaissance.

11004

Switzerland's Armored Equipment

18010337d Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian
No 3, Mar 88 (signed to press 5 Mar 88) pp 26-30

[Article by Col Ye. Viktorov]

[Text] Switzerland is a neutral state. At the same time, this country's military leadership devotes considerable attention to maintaining armed forces at the needed combat capability by implementing the appropriate measures, including providing them with modern weapons and combat equipment.

The needs of Swiss ground troops in the principal armed services are satisfied to a significant extent by the capabilities of the country's own military industry. In particular, Switzerland is said to be a traditional exporter of antiaircraft artillery guns. The Movag Company [transliteration], which exports a significant part of its products, plays a noticeable role in developing and manufacturing tracked and wheeled armored vehicles.

The tank park of the Swiss ground troops now contains over 870 units. It consists mainly of Pz61 and Pz68 tanks produced respectively in the 1960s and in the 1970s by a state-owned plant in the city of Thun. The inventory still includes around 300 obsolete English Centurion tanks purchased in the mid-1950s.

Light French AMX-13 tanks (200 units) were removed from the inventory in the early 1980s. The first 34 West German Leopard-2 tanks, which were designated the Pz87, were delivered in 1987 in compliance with a decision adopted earlier by the ground troops. The remaining 346 vehicles will be manufactured under a license at the state-owned plant mentioned above.

American M113 tracked armored personnel carriers are the principal vehicles used for infantry transport. There are around 1,500 of them, including a large quantity of vehicles intended for different purposes designed on the basis of this APC.

Models of Swiss armored equipment presently in the inventory of Swiss ground troops or created by local industry for export are described below. Their combat characteristics are presented in the table. The Pz61 tank (Figure 1) [figures not reproduced] was in production up to 1966 (150 units were delivered). The hull and turret are cast. Maximum thickness of armor is 120 mm. The tank has a traditional layout with the control compartment in front and the engine and transmission compartment located in the rear of the vehicle. There are two cupolas on the roof of the turret—commander's (on the right) and loader's. A 7.5-mm antiaircraft machinegun is mounted above the latter on a ring mount.

The armament of the Pz61 tank consists mainly of an English 105-mm rifled gun and a coaxial 7.5-mm machinegun (a 20-mm caliber gun was on the first models). A unit of fire is 52 rounds and 5,400 cartridges. The gun fires rounds containing APDS shots, and armor-piercing and smoke shells.

The gunner has a periscopic sight with eightfold magnification. The commander uses an optical range finder. Eight periscopes are installed about the perimeter of his cupola for observation of the terrain.

The power unit includes a West German V-8 MB 837 Ba-500 diesel engine and a Swiss-made SLM semiautomatic transmission. The track system consists of six road wheels and three top rollers (on each side), and metallic tracks with exposed hinges.

The Pz68 tank is a further development of the Pz61 tank. The first experimental model was made in 1968. Production of Pz68 tanks continued to 1984. They were produced in four series. A total of 390 units were delivered to the ground troops.

In contrast to the Pz61 base model, the Pz68 tank has a system that stabilizes the gun in two aiming planes. Installation of an improved fire control system with a laser range finder is possible in the future. There is a hatch on the left side of the turret through which a unit of fire (56 rounds) can be stowed. A heat-insulating jacket is fitted over the gun barrel to protect it from sharp temperature fluctuations. Three-tube smoke grenade launchers are mounted on the sides of the turret. It contains an augmented engine, and the transmission was somewhat modified (six reverse gears instead of two). The tracks are equipped with rubber cushions. The width and length of the track links were increased.

Наименование образца (1)	(2) Боевая масса, т / экипаж (десант), человек (3)	(4) Габариты, м: высота / длина[1] × ширина (5)	(6) Калибр оружия, мм: пушки / пулеметов (7)	(8) Мощность двигателя, л. с.	(9) Максимальная скорость, км/ч / запас хода, км (10)
Танк Pz61 (11)	38 / 4	2,85 / 6,78 × 3,08	105 / 2×7,5	630	55 / 300
Танк Pz68	39,7 / 4	2,88 / 6,88 × 3,14	105 / 2×7,5	660	55 / 350
Боевая машина пехоты «Торнадо» (12)	20,5 / 2 (8)	2,9 / 6 × 3,15	20 / 2 × 7,62	430	70 / 600
Гусеничный бронетранспортер «Пират-18» (13)	18,5 / 1 (11)	1,8 / 6,1 × 2,9	20 / 7,62	430	70 / 400
Колесный (6×6) бронетранспортер «Пирана» (14)	9,6 / 2 (10)	1,85[2] / 5,97 × 2,5	— / 7,62	300	100 / 600
Колесная (8×8) бронированная машина «Шарк» (15)	22 / 3	2,7 / 7,5 × 3	105 / 7,62	530	100 / 500
Колесный (4×4) бронетранспортер серии MR-8 (16)	8,2 / 2 (5)	2,2 / 5,3 × 2,2	— / 7,62	160	80 / 400
Колесный (4×4) бронетранспортер «Роланд» (17)	4,7 / 3 (3)	2 / 4,4 × 2	— / 7,62	202	110 / 550
Колесный (4×4) бронетранспортер «Гренадир» (18)	6,1 / 1 (8)	2,12 / 4,84 × 2,3	20 / —	202	100 / 550
Разведывательный бронеавтомобиль «Спай» (19)	7,5 / 3	2,3 / 4,5 × 2,5	— / 12,7; 7,62	205	110 / 700

[1] Приводится длина по корпусу. (20)
[2] Высота по крыше корпуса. (21)

Tactical-technical Characteristics of Models of Swiss Armored Equipment in the Inventory of Swiss Ground Forces and Made for Export

Key:
1. Model
2. Fighting weight, tons
3. Crew (assault), persons
4. Dimensions, m: height
5. Length x width
6. Weapon caliber, mm: guns
7. Machineguns
8. Engine horsepower
9. Maximum speed, km/hr
10. Range, km
11. Tank
12. Tornado infantry fighting vehicle
13. Pirate-18 tracked armored personnel carrier
14. Wheeled (6x6) Piranha armored personnel carrier
15. Wheeled (8x8) Shark armored vehicle
16. Series MR-8 wheeled (4x4) armored personnel carrier
17. Roland wheeled (4x4) armored personnel carrier
18. Grenadier wheeled (4x4) armored personnel carrier
19. Spy armored reconnaissance vehicle
20. Hull lengths are given
21. Height to hull roof

The Pz65 armored recovery vehicle is equipped with a spade, an A-frame crane boom, a main and auxiliary winch and the necessary tools. The vehicle crew consists of five persons, and the vehicle is armed with a 7.5-mm machinegun and an eight-tube grenade launcher used to create smoke screens.

The armored bridgelayer has a nonfolding bridge girder. A special telescopic beam equipped with a hydromechanical drive is used to lay and remove the bridge. It can span an obstacle 18 m wide, and its loading capacity class is 50.

A 155-mm self-propelled gun designed out of the Pz68 tank was not adopted by the Swiss ground troops. The American M109 155-mm self- propelled howitzer was purchased in its place (380 units were delivered). A 35-mm twin self-propelled artillery mount similar to the West German Gepard self-propelled antiaircraft artillery mount also remained in the experimental stage.

The **Tornado** infantry fighting vehicle (Figure 2) was developed by Movag as an independent project. The first experimental model of the vehicle appeared in 1968.

The vehicle has a welded sealed armored hull; its front section contains the engine-transmission compartment (on the right) and a control compartment. A rotating turret with a mounting on which a 20-mm automatic cannon is installed is located in the central part of the hull. Two remote-controlled 7.62-mm machineguns are installed on swiveling supports on the roof of the front section of the hull (near the sides). Small-arms firing ports are present on the sides of the troop compartment. The IFV is equipped with a filtered ventilation unit.

The diesel engine, transmission and turning mechanism are designed as a single unit. The undercarriage uses a torsion-bar suspension with hydraulic shock absorbers on the first, second and sixth road wheels.

Several experimental models of the Tornado IFV were produced later on, and they underwent plant and troop trials. As a result of further development a modernized version of this vehicle, which was named the Typhoon, was created in the late 1970s. It is intended for export, but as with the Tornado IFV, no country has yet purchased it. The main thing that makes this vehicle different from the Tornado IFV is the presence of a two-man armored turret equipped with a 25-mm automatic cannon.

Between 1956 and 1965 the Movag Company successively designed experimental models of five modifications of the Pirate tracked armored personnel carrier; however, it has not been adopted by the Swiss ground troops either. The APC of the latest modification, the **Pirate-18,** had a sealed hull welded together out of sheet armor 10-20 mm thick. There are two large entrance hatches at the stern of the vehicle. The engine is in the middle part of the hull between the fighting and troop compartments. A 20-mm automatic cannon is installed in the one-man rotating armored turret. The APC is equipped with a filtered ventilation system.

In the early 1970s the Movag Company designed a family of amphibious Piranha wheeled armored vehicles. They were designed in two-, three- and four-axle versions. Moreover these vehicles were intended for use as both armored personnel carriers and various armament platforms.

The base model of the **Piranha** wheeled (6x6) armored personnel carrier has a welded armored hull offering protection against bullets and artillery shell fragments. An American 6V-53T diesel engine and an Allison automatic transmission are installed on the right in its forward section. The driver sits to the left. All wheels have an independent suspension: coil springs on the front wheels and torsion bars on the rear wheels. The vehicle is propelled over water by two propellers on the sides of the aft section of the hull.

Various types of armament can be installed on the armored personnel carrier—machineguns, guns or missile launchers. In particular this armored personnel carrier was used as the basis for creating a self-propelled antitank missile launcher system (Figure 3), which will enter the inventory of the Swiss ground troops in the early 1990s (there are plans for purchasing a total of 310 units). A one-man armored turret with two TOW-2 antitank guided missile launchers (with 10 missiles to a unit of fire) and sighting equipment is in the middle part of the hull. The fighting weight of a self-propelled weapon system is 11 tons, it carries a crew of five, its maximum highway speed is 100 km/hr, and its range is 500 km.

Canada's General Motors of Canada designed a family of wheeled (6x6) armored vehicles on the basis of the Piranha armored personnel carrier under a Swiss license. These vehicles were delivered to Canadian ground troops in late 1982 (491 units in all).

Three variants of the vehicle have been produced: The Grizzly wheeled armored personnel carrier (269 units), the Cougar fire support vehicle (195) and the Husky recovery vehicle (27). The Grizzly APC is armed with two machineguns (12.7 and 7.62 mm caliber) mounted on an armored turret. The vehicle's capacity is nine persons including a crew of three. The Cougar armored vehicle bears a turret from the Scorpion light reconnaissance tank with a 76-mm gun.

The LAV-25, a wheeled armored vehicle, was designed in 1982 on the basis of the Piranha armored personnel carrier by the Canadian company mentioned above in response to an order from the U.S. Marines. A total of 758 units are to be delivered, including special-purpose vehicles. The LAV-25 is a wheeled (8x8) Piranha APC bearing an American two-man armored turret and armed with a 25-mm automatic cannon and a 7.62-mm coaxial machinegun. The Piranha wheeled (6x6) APC is also produced under a license by Chile's Kardoyen [transliteration], which has delivered around 200 such vehicles to its ground troops.

In the early 1980s Movag designed experimental models of the Shark wheeled (8x8) armored vehicle on the basis of the Piranha armored personnel carrier. Different types of principal armament were installed on it: a 105-mm low-impulse rifled cannon produced by West Germany's Rheinmetall, a twin 30-mm antiaircraft artillery mount, a French FL-20 turret equipped with a 105-mm gun, an ADATS (Air Defense Antitank System) multipurpose missile system and a Crotale surface-to-air missile system.

Switzerland's Movag designed the series MR-8 wheeled (4x4) armored personnel carrier in the late 1950s. This vehicle was subsequently produced under a license in the FRG in two variants, and it was supplied to police subunits and border troops (a total of around 600 units).

The two variants of the vehicle differed in their armament—a 7.62-mm machinegun or a 20-mm cannon. These armored personnel carriers are now being replaced by TM 170 wheeled (4x4) armored personnel carriers produced by West Germany's Theissen Mashinenbau.

The Roland wheeled (4x4) armored personnel carrier (Figure 4) designed in the early 1960s by the Movag Company is in the inventory of the ground troops of Argentina, Bolivia, Iraq and Peru. It can be used not only to transport infantry but also to carry out various missions—reconnaissance, patrolling, communications and cargo transport.

The hull of the Roland APC is welded out of rolled sheet armor. Both of its sides contain hatches for troop entry and exit. In addition there is a door at the stern of the vehicle. The engine compartment is in the rear portion of the hull and to the left. The armored personnel carrier is not amphibious, and it is armed with a 7.62-mm machinegun.

In 1966 the Movag Company demonstrated an experimental model of the Grenadier wheeled (4x4) armored personnel carrier (Figure 5), which was subsequently purchased by a number of countries. The APC's hull is made from bullet-proof armor. The diesel engine and mechanical transmission are installed in the right side of the forward section of the hull. A propeller is installed at the stern of the vehicle for travel over the water surface. A 7.62-mm machinegun or a 20-mm automatic cannon can be mounted in the armored turret.

Among other wheeled armored vehicles designed in recent years by the Movag company, mention should be made of the Spy armored reconnaissance vehicle. This two-axle vehicle has a sealed armored hull with a two-man turret bearing 12.7- and 7.62-mm machineguns installed toward the rear. The engine compartment is in front and to the right, and the driver sits to the left. The armored vehicle carries a crew of three.

It is evident from the above that Switzerland devotes significant attention to equipping its ground troops with contemporary models of armored equipment, including locally developed and produced equipment. Switzerland's Movag is simultaneously noted to play an active role in designing wheeled armored vehicles of various purposes to be sold to other countries.

11004

American M203 Barrel-Mounted Rifle Grenade Launcher

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[Article by Lt Col (Res) A. Fillippov, candidate of technical sciences]

[Text] In the second half of the 1960s America's AAI Corporation developed a single-shot automatic antipersonnel 40-mm barrel-mounted rifle grenade launcher, the XM148, in response to an order from the command of the U.S. ground troops. Its experimental models underwent comprehensive proving range and troop trials, including during the war in Southeast Asia. Following some final improvements, the grenade launcher was adopted by the U.S. Army in 1970 with the designation M203, replacing the M79 40-mm hand-held antipersonnel grenade launcher. The M203 is now supplied as a unit with the M16A1 5.56-mm automatic rifle (with the M16A2 as of 1984) to infantry and motorized infantry companies (19 and 18 units in each respectively) and to other subunits of the U.S. ground troops.

The M203 barrel-mounted rifle grenade launcher (Figure 1) [figures not reproduced] consists of a body equipped with a trigger mechanism, a barrel, a swinging grip with a locking mechanism and mechanical sights. The body consists of a thin-walled cylinder with the breech end covered by the trigger mechanism. The top of the breech end bears a slot for the tooth of a spring extractor, while the bottom bears two slots (a wide one through which a round is loaded into the barrel and a narrow one for a barrel lug that keeps the barrel from moving on its axis). The inner surface of the body is smooth, and the outer surface is ribbed. The body is secured to the lower part of the rifle barrel by means of a ring and clip with screws.

The main components of the trigger mechanism are: A striker with a striker spring located at the center of the body's butt end; a striker cocking lever with its rod extending out beyond the butt end of the body; a safety that locks the striker's position; a trigger located on the right side of the body.

The barrel is mounted inside the grenade launcher's body. The bore is rifled (six grooves with a lead of 1,220 mm). The breech end of the barrel is connected by pins to the swinging grip which is made with a spring strip with a locking lug and a lever used to lock and open the barrel.

The tangent rear sight and front sight of the rifle are used for flat trajectory fire from the M203 barrel-mounted grenade launcher against observed targets 50-250 m away. The tangent sight is mounted on the rifle's stock fore-end (behind the front sight's base). A quadrant mounted on the rifle grip is used for long-range fire (up to 400 m). For high trajectory fire against area targets, the rifle butt is rested against the ground.

The weight of an unloaded grenade launcher is 1.36 kg, and its length is 389 mm. Besides the rifle and the M203, the weapon outfit includes 150 cartridges, 12 rounds, a kit of spare parts, tools and accessories, and sights. The weapon weighs around 5.4 kg in combat configuration, and 8.5 kg with the entire outfit.

To load the grenade launcher, the swinging grip is turned upward to open the barrel (the locking lug disengages from the body), and the barrel moves all the way forward; the round is fed into the breech of the barrel through the wide slot in the body. Then the barrel is moved back and locked (in this case the locking lug engages with a projection on the butt end of the body, and the extractor tooth grasps the cartridge case flange).

After the barrel is loaded, the striker is cocked and the safety is set if necessary (for example if the fire position is to be switched). After the weapon is fired, the barrel unlocks and moves all the way forward. The cartridge case is held in place by the extractor tooth until it emerges from the barrel bore, after which it falls out through the wide slot in the body. After this, the grenade launcher may be reloaded with a new round.

The grenade launcher is used for flat trajectory fire from prone position, from one knee or standing with the rifle butt resting against the shoulder. The range of effective fire against point targets does not exceed 150 mm, while range against area targets does not exceed 350 m.

The M203 fires 40-mm QF fixed rounds containing fragmentation, shaped-charge, smoke, illuminating, signaling and training grenades (Figure 2). The first are intended for destruction chiefly of enemy manpower in the open, while hollow-charge fragmentation grenades are intended against lightly armored targets. Rounds containing grenades loaded with lethal fragments (balls) and CS irritant-action war gas were developed in recent years. A QF fixed round consists of a grenade, a cartridge case, a propellant charge and a small percussion cap. Rounds are stored and carried in a pouch (six to a pouch).

The M381 round and its subsequent modifications (M386, M406, M441) are fitted with a fragmentation grenade. The weight of a round is 227 gm, and its length is 99 mm. The muzzle velocity of the grenade is 76 m/sec, and the maximum range of fire is 400 m. The grenade consists of a spherical fragmentation element, a fuse, an assembly sleeve and a ballistic tip.

The body of the fragmentation element is made by winding steel wire with a square cross section (2.5x2.5 mm). The wire is scored at 3 mm intervals so that it will break up into fragments of the required weight when the grenade explodes (the standard weight of one fragment is 0.15 gm). The rows of wire are sealed together with solder. High explosive (hexogen and trotyl) compound is poured into the body.

The fragmentation element is secured to the assembly sleeve, which is made with guide lugs. After the assembly sleeve is pressed into the cartridge case the nose percussion fuse is screwed into the fragmentation element and the sleeve is capped with the ballistic tip. When the grenade explodes, around 500 fragments form, dispersing with an initial velocity of up to 1,500 m/sec. The radius of destruction of personnel in the open with a 50 percent probability is 4.5 m.

The M463 round differs from the M381 (and its other modifications) by the type of powder in the propellant charge. It uses a smokeless powder. Besides a label, two splines on the cartridge case flange distinguish the M463 visually from other types of rounds. This round is used predominantly for covert fire from ambushes, at night and when carrying out combat missions in the enemy rear.

The M397 round has a "skipping" fragmentation grenade. It weighs 230 gm, and its length is 103 mm. The grenade in this round contains the same elements as the grenade in the M381 round, but it is equipped with a propellant powder charge and igniter so that it will explode in the air above the ground. The charge is in the nose section around the fuse housing. When the grenade contacts the ground, the nose fuse is activated simultaneously with ignition of the propellant charge by the igniter and explosion of the delay element of the igniter. Powder gases formed by combustion of the propellant charge eject the fragmentation element together with its igniter out of the ballistic tip of the grenade to a height of 2 m. This element explodes after 80 microseconds. It is believed that when the grenade explodes at a height of 1.2-1.5 m, its fragmentation action is approximately 1.5 times greater than in the case of a ground burst. In addition explosion of the grenade above the ground creates the possibility for destroying enemy personnel in foxholes, trenches and communication trenches.

The M433 round is outfitted with a shaped charge grenade (it weighs 173 gm, and its length is 83 mm). The grenade body is cylindrical in shape. It is made from high-strength aluminum alloy. Grooves are cut into the outer surface of the body so that it would disintegrate as required when it explodes. The body is filled with a prefabricated block of explosive consisting of hexogen. The hollow of this charge is faced with a copper funnel having a 60o angle at its apex. The grenade is fitted with a combined nose-face piezoelectric fuse. Its fragmentation action is less than that of the grenade in the M381 round. Therefore, it is recommended that rounds containing shaped charge grenades be used mainly against lightly armed targets at ranges up to 150 m. The armor-piercing capability of a grenade is 50 mm at a normal angle of incidence.

The XM576E2 round contains a grenade having a body filled with 27 steel balls (each weighing 1.3 gm). After the grenade flies out of the bore, its body disintegrates, and the balls fly out of the recess in the base in response to

centrifugal force and scatter within a narrow sector. Their kinetic energy is sufficient to penetrate a pine board 20 mm thick from a distance of up to 35 m. A round with such a grenade is intended chiefly for self-defense during low visibility and at night. The weapon is fired upward in the direction of attacking enemy manpower.

The XM651E1 round, which is equipped with a grenade filled with a mixture of CS irritant gas and a pyrotechnical composite, can be used mainly to "smoke out" enemy manpower from light field shelters, after which the latter can be destroyed by small arms fire. The grenade is fitted with a impact fuse having a remote arming mechanism. Burning of the pyrotechnic composite causes the CS war gas to sublimate into a smoke-like state. A plastic plug is forced out of the body by excess pressure, and the sublimation products escape into the atmosphere to form an irritant (chiefly tearing) cloud. Sublimation continues for 30 sec. The area affected is approximately 80 m square.

Some rounds containing smoke and illumination grenades are equipped with parachutes. Rounds containing practice grenades loaded with inert material are used to train personnel in the rules and procedures of firing the M203 barrel-mounted grenade launcher. For example the M407A1 round, which simulates type M381 rounds, has a standard cartridge case and a plastic body containing a training grenade filled with inert matter. When the training grenade of an XM781 round, which simulates an M433 round, encounters an obstacle, its body disintegrates to form an orange cloud.

In the mid-1980s American specialists created an improved version of the barrel-mounted grenade launcher, which was designated the PI-M203. The elements securing it to the rifle were altered somewhat (to allow faster attachment and removal), and new sights were mounted.

11004

Modern Aerial Combat

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[Article by Col V. Kirillov, candidate of military sciences]

[Text] According to the foreign press, fighters specially intended for aerial combat make up a significant proportion of tactical aviation in the air forces of NATO bloc states. Their principal missions are to repel enemy air raids on friendly troop groupings and rear installations—that is, air defense, and escort and cover of friendly airplanes making strikes on the enemy. Destruction of enemy airplanes in the air is believed to be the principal method of the combat activities of these fighters.

Some views of NATO specialists on aerial combat today and in the immediate future are presented below on the basis of information in the Western military press.

Considering the great role played by fighter aviation in the various combat missions of air and air defense forces, the military leadership of the Western countries, and chiefly the USA, devotes considerable attention to its development. In this case simultaneously with improving the airplanes, new methods of their combat use are being developed and the tactics of aerial combat are being reexamined.

Prior to the 1980s aerial combat—organized armed encounter of airplanes in the air—was close and fluid. Distances between dueling fighters were short because of weapon capabilities, while the need for constantly changing the direction of flight was a product of the need for maneuvering the airplane into a confined area of possible attack that moved in conformity with the opponent's movements. A frontal attack (attack on collision courses) was excluded because the authorized missile launch ranges were inconsistent with the high speeds of convergence of the airplanes.

But after third-generation jet fighters were armed with medium-range guided missiles, the boundaries of the area of possible attack expanded noticeably. This made it possible to begin a transition to aerial combat from all angles.

Thus the first frontal attacks were noted to occur in 1982 in the sky over Lebanon. The Israeli side was represented by F-15 fighters equipped with AIM-7F Sparrow guided missiles. In connection with this, foreign specialists predicted fundamental changes in aerial combat. However, it was revealed that the new weaponry required special conditions of combat use. There were limits on launching missiles in the lower hemisphere (due to ground interference), on maneuver of the opponent at the time of launch, and on target recognition in saturated airspace. The guidance process took longer because the target had to be "illuminated" by the onboard radar set until it was hit by the missile. In addition a fighter could simultaneously lock on and track only one target.

It was reported in the foreign press that the factors mentioned above made frontal missile attacks only a sporadic phenomenon. This was confirmed by the ratio of use of Sparrow guided missiles and Sidewinder short-range rockets, which was approximately 1:3. Thus close fluid battle, which retains its former countenance and traditional methods of conduct, has clearly prevailed over combat at moderate ranges. However, the latter has become a reality, and it has assumed a firm foothold in the manuals and in the air force personnel training programs of many capitalist states.

Aerial combat experience acquired in wars, in armed conflicts and during test flights compelled foreign military specialists to introduce corrections into the selected paths of development of fighter tactics. In their opinion the following basic factors affect the nature of modern aerial combat: use of weapons with active guidance systems, enlargement of the area of possible attacks, extremely high mobility and greater individual protection.

Use of Weapons with Active Guidance Systems

Use of weapons with active guidance systems, it is noted in the Western press, should eliminate the rigid constraints keeping all-aspect aerial combat from strengthening its position. According to calculations by NATO military experts the possibilities of the bloc's air forces for 70 percent interception of airborne targets outside the visual range would be ensured by F-15 fighters of the U.S. Air Force based in Europe as well as by F-16s of the Belgian, Dutch, Danish and Norwegian air forces after they are armed with AIM-120 air-to-air missiles.

What makes this missile different from the existing AIM-7F Sparrow guided missile is the presence of an active radar homing head that can control flight to the target in the final portion of the trajectory independently of an external object. Thus after launching its missiles the attacking fighter is "freed" of the need for tracking it, and he can carry out any maneuver dictated by the situation. The proposed replacement of Sparrow guided missiles by AIM-120 missiles is to be accompanied by improvements in onboard radar stations. They will be given a capability for operating in what is called "sorting" mode, where the radar station will automatically lock onto several targets in a sequence determined by the level of the threat. After the ratio between the approach velocity and the range to enemy airplanes is established, all traces on the sight screen are replaced by priority symbols, allowing the pilot to plan his attacks. Each successively launched AIM- 120 missile switches to independent approach of the tracked target following its lock-on by the active radar homing head.

According to the journal AVIATION WEEK AND SPACE TECHNOLOGY the pilot of an improved F-16C fighter (equipped with an AN/APG-68 onboard radar set and a sufficient number of AIM-120 guided missiles) can simultaneously track up to eight airborne targets and launch missiles at them with a very short time interval between launchings.

It was written in the journal DEFENSE NATIONAL that independent flight of AIM-120 guided missiles (with a launching range of 48-64 km under ideal target detection conditions) should increase the survivability of fighters, inasmuch as the homing weapon takes on part of the functions of the airplane and pilot associated with aerial combat. In addition the fact itself of creation of a guided missile that can be launched before the fighter reaches the zone of close mobile combat confirms the tendency for growth of the role of weapons (fire) in comparison with maneuver, and for reduction of the significance of close aerial combat in the missions associated with attaining air superiority.

In order to evaluate the characteristics of the AIM-120 missile and develop new tactics, the U.S. Air Force conducted tests on it using a controlled simulation system with the participation of 56 pilots. Two sides (Red and Blue) carrying out typical combat missions participated in the simulated combat operations. In total of over 20,000 simulated sorties and around 33,000 simulated missile launchings were carried out (the system could support the activities of 12 airplanes and record 12 launchings simultaneously). The fighters of each side were controlled from their own command post. For technical reasons the simulated adversaries were launched from their jump-off position at reduced range. Thus the F-15 and F-16 fighters began approaching from a range of 92 km during exercises concerned with free group aerial combat (2x2 or 2x4). In accordance with the conditions of another exercise, a group of four fighters of the same type covered an airfield against a raid by an attack group of eight airplanes of the simulated adversary including bombers and a fighter escort. Inferior in numbers to the simulated enemy, the defending side basically stuck to the tactics of penetrating to the bombers.

Presenting some of the results of the simulation, the journal AVIATION WEEK AND SPACE TECHNOLOGY wrote that only 13 percent of all simulated launchings were carried out at the maximum range established for the given conditions (31 km). The pattern of the last air battles of the Near East were basically repeated: As with the Sparrow guided missiles, the AIM-120 missiles required simplified conditions of combat use, while the simulated adversary was able to find effective protective measures and make these conditions more complicated. The journal suggested the following as the most promising defensive measures: conducting reconnaissance of the airspace to considerable depth, implementing intensive electronic countermeasures, and employing nonstandard combat formations.

The results of deep reconnaissance of the airspace and electronic warfare depended on the equipment available to the sides and the level of organization of the combat activities. It was noted in particular that presence of airborne search systems—AWACS airplanes—made it possible for the defending side to detect the enemy sooner, and thus partially neutralize his offensive potential. The resulting time reserve was utilized by the commander of the group covering the airfield to work out an optimum tactical plan and to put defensive resources corresponding to the situation into play. Among the latter, jammers were found to be the most appropriate. It was noted in the American press that intensive jamming reduced the range of detection of airborne targets and decreased the precision of determining their coordinates. Therefore the simulated adversary

had to launch his missiles following a delay—at reduced range, while in some cases he was compelled to switch to visual detection of the defending side's fighters. The "sorting" tracking mode was left unutilized, and the AIM-120 missiles could not be launched from medium range. When it did occur, aerial combat was close and mobile.

Reorganization of the combat formation of the attack groups for counterattack purposes reflected the tactical training level of the personnel. Simulation did not produce unambiguous answers in this division of the program: The only result was to reject the former practice of using mixed groups of F-15 and F-16 fighters, since their destructive capabilities were almost equalized after they were equipped with AIM-120 guided missiles. Nonstandard combat formations differed from previously known ones only in the pattern of their formation and a changed distribution of tasks among components of the formations. Most requirements on disposition of fighter forces remained traditional: centralized control, dependable coordination, freedom of maneuver, swift changes of the formation and change of the functions of groups intended for different tactical purposes in response to abrupt changes in the situation. Consideration of the surveillance capabilities of AWACS airplanes and camouflage of the combat formation on the background of manmade and natural interference became mandatory.

The ratio of velocities—an element which formerly played the main role in target interception, especially when a target had to be chased on a pursuit course—was given a lesser value in the tactics of direct penetration to simulated enemy bombers practiced by fighters covering the airfield. The tactics of capitalizing upon breaches in the escort group assumed the forefront. It is noted that when the size of the latter was superior to that of the interceptors, it was able to organize a dependable screen. The situation changed dramatically after quantitative equalization of the forces, such that owing to their losses the escort fighters could not ensure the safety of the bombers. Differences in the information capabilities of the sides, which directly affected the use of medium-range weapons, began to have their effect. With deeper penetration into the simulated enemy's airspace the information capabilities of the attacking side, which was compelled to switch to "self-service" mode, worsened, while the defenders were able to operate under the direct control of ground and air command posts.

Enlargement of the Area of Possible Attacks

Western experts emphasize that maneuver and fire are the essence of aerial combat. The pilot maneuvers his airplane into an advantageous position for attack, and then he employs fire to attain the end goal of combat—destruction of the airborne opponent. In their opinion the latter component of the indivisible "maneuver-fire" duality occupies the dominant position. It determines the content of the former—that is, the turning radius, accelerations and the time required to maneuver (by way of a combination of turns in any plane) to get the fighter to the line from which its weapons could be employed (from which cannons could be fired and missiles could be launched). After airplanes were outfitted with medium-range missiles this line was moved significantly farther away from the target, thus extending the attack phase in space. The outward characteristics of the phase of combat preceding attack—closing in—also changed.

According to the foreign press the experience of aerial combat in the Middle East showed that in all-aspect combat, an attack strictly on a head-on course, which provides for the maximum range of missile launch, is the most advantageous. If a fighter were able to close in undetected, he would try to attain the target's flight axis by the end of the closing-in phase. With greater aspect he was compelled to approach the simulated adversary more closely, thus worsening the conditions of the attack. Missiles that are able to home in the terminal portion of the trajectory (the AIM-120 for example) can partially eliminate this shortcoming, but the need for maneuvering the airplane into the preferred position still remains.

The results of simulated aerial combat carried out in the USA using a new generation of guided missiles show that the role and significance of maneuver remain the same. Only its form and parameters are changing, inasmuch as the range of missile launch greatly exceeds an airplane's turning radius. American specialists note that the opponents can no longer change places several times in the course of maneuver, however, the initial position attained prior to the attack must be characterized by a certain aspect, speed and height in relation to the target. The subsequent flight phases, in which the outcome of the battle is decided, require this. The assessment is made here on the basis of two criteria—forestalling the opponent in using a weapon and minimizing the probability of a retaliatory strike. Keeping one's own airplane out of the opponent's zone of effective weapon use is believed to be the best variant. At the same time, dependable guidance of the missiles to the target must be ensured. A speed margin must be utilized to maintain the level of energy required to break off from the attack and to continue combat.

In the opinion of Western experts the relative importance of maneuvers carried out by a fighter a considerable distance from a detected opponent will increase in aerial combat of the immediate future. As a rule such maneuvers are typified by broad scope and moderate accelerations. Experiments conducted by West Germany's Messerschmitt-Boelkow-Blohm showed that sustained turns with a maximum acceleration of 4-5 g dominated. Inasmuch as closing in and the attack did not require highly convoluted flight trajectories, specialists concluded that aerial combat could be conducted at moderate range and at supersonic speed, especially at high altitude.

The journal INTERNATIONAL DEFENSE REVIEW wrote that presently existing fighters cannot be said to be truly supersonic. The characteristics of an airplane are judged not by the maximum velocity that can be attained but rather by the average speed that is sustained in the course of a combat mission while carrying a standard payload. Thus although second and third generation fighters were intended to fly at a velocity exceeding twice the speed of sound, in Vietnam and in the Near East they maneuvered in aerial combat at a subsonic speed ensuring the greatest angular velocity of a turn. Only in straight flight while closing in or breaking off from the enemy (when disengaging from combat) did the Mach number occasionally exceed unity. Forced turns in extreme situations began to be carried out under these conditions, but because of unfavorable acceleration the airplane had to be returned to the near- sonic range of flying velocities.

Another reason why modern fighters do not utilize supersonic flight velocities in combat, the journal believes, is the limits of their own information field created by the onboard radar station. For example in a typical situation, F-15 Eagles were committed to combat from a zone of operational readiness in the air, where they maintained a standing patrol in an economical subsonic mode. On detecting a simulated adversary at a range of 74 km, they were unable to accelerate to maximum velocity (Mach 2.5). Such acceleration would not have been required by the conditions of closing in and attack anyway, since the pilot would not have enough time remaining to carry out the operations of locking on the target, tracking it and aiming at it. Thus excessive closing-in speed could cause an attack to fail.

At the same time the simulation results showed that on the whole, a faster interceptor could carry out its mission in less time and maintain a position from which it can be immediately committed to combat even when its mission might be to repel a raid by fast attack aircraft. This is why cruising flight at high supersonic speeds is included among the requirements imposed by the U.S. Air Force on any future fighter.

As was noted above, improvements in aircraft weapons increased the area of possible attacks and brought on the possibility for simultaneous guidance of missiles to several targets. In the opinion of foreign military specialists this should result in a further reduction of the size of fighter groups participating in a single battle—that is, the airspace will undergo "rarefaction." Another reason why the latter will occur is that a fighter equipped with the new weapons requires more room for maneuver. All of this is having an effect on the organization of combat formations, and it is leading to unavoidable break-up of the combat formation, which is felt to be impossible without dependable channels by which to exchange information between fighters united together by a single combat plan. Therefore besides development of weapons and airplanes, creation of special systems for obtaining and exchanging information, including between airplanes and fighter groups, is getting considerable attention in the USA and in other NATO countries.

The so-called aerial head-on engagement, in which the opponents try to resolve the outcome of a duel by offense—in accordance with the principle of "repelling an attack by an attack", is encountered more and more frequently in the theoretical offerings of Western military experts. For example it is believed that fighters serving as escorts to strike groups should enter into combat only in the event of extreme need—that is, when airplanes in the strike group are threatened. After carrying out a short maneuver and making their encounter attack on the approaching enemy, they are obligated to resume their place in the combat formation. Any kind of feints, false maneuvers and other tactics as well as assistance to auxiliary forces deep within enemy territory are practically excluded. Foreign specialists believe that there is not much hope for success in a meeting engagement without superiority in the range of detection and use of weapons.

Supermaneuverability

Western theorists have attacked close aerial combat on many occasions. They have "buried" it several times—the last time after the advent of medium-range guided missiles. But aerial combat stubbornly refused to leave the arena of aerial combat, ignoring some of the "new" conceptions in accordance with which requirements on aviation equipment were developed. The American multipurpose "heavy" Phantom fighters and high- speed F-104 fighters were ill-suited to the close combat that was required by the situation.

Recently after analyzing the simulation results, representatives of West Germany's Messerschmitt-Boelkow-Blohm concluded that it would be risky to enhance an airplane's capabilities in aerial combat at medium range at the expense of poorer characteristics in close combat. In their opinion a fighter must possess high maneuverability at subsonic speeds at low and moderate altitudes, and at supersonic speeds at high altitudes.

In many cases simulated aerial confrontations between airplanes equipped with AIM-120 missiles ended in close fluid combat, even though they began at moderate range. Rather often the simulated enemy was able to overcome the effect of surprise and limit the possibility of long-range detection and identification of his airplanes. As before, close combat was characterized by a wide assortment of unsustained (forced) maneuvers involving deceleration, and therefore success in it belonged to the fighter with the lower relative load on the wings and the higher thrust- to-weight ratio (sufficient to restore the needed level of power).

It was noted in the foreign press that the power characteristics of fighters are now being increased at great cost. Thus the cost of airplanes rises dramatically when their

thrust-to-weight ratio is raised above 1.2. As a result given constant budget allocations, their number in the air force may decrease to an unacceptable level. The possibilities for maneuver have also approached their limit. In the opinion of Western experts the maximum angular turning velocity (20-25 degrees per second) that has now been attained is very difficult to surpass owing to the fact that trapezoidal and triangular wings have limits in relation to unit load and strength. And yet, the desire to have an airplane with greater angular velocity than that of an opposing fighter remains. The reason for this is that if the angular velocity of an experienced pilot's aircraft is just 3 degrees per second greater than that of his adversary, he would be able to assume a position for weapon use first.

Foreign military specialists have studied aerial combat between two airplanes with "power" and aerodynamic capabilities at their highest possible. Given their equal offensive capabilities, pilots of the same training level and the absence of the element of surprise, combat proceeded in what we can call a "no-man's land." Simulation from which random factors were distilled showed that only the pilot who disengaged from combat first—that is, who ceased maneuvering because of running short of fuel—was placed in jeopardy.

Given the way things are now, foreign specialists associate hope for success in close combat with extreme flight conditions and with utilizing what is known as supermaneuverability in aerial combat.

An airplane's supermaneuverability is defined as its possibility for turning without stalling at angles of attack to 70 degrees, and changing its position in space without affecting the flight trajectory, or on the other hand, changing the latter while maintaining position in relation to one or several axes. It is achieved by means of supplementary lateral control surfaces, and by combining the systems for controlling aerodynamic forces and fire. The behavior of a supermaneuverable fighter in close combat is typified by abrupt short-term increases in the angle of attack coupled with swift turning toward the opponent (or away from him), followed by recovery of the former position. The capability for adjusting the position of the fuselage in the vertical and horizontal planes irrespective of the airplane's line of travel is said to be especially important when firing cannons.

The results of tests conducted in the USA in a realistic simulation system showed that a supermaneuverable airplane is not less than twice as effective as a conventional airplane in close aerial combat. When cannons and short-range missiles were used, it won five out of every six battles and was able to hold its own against two conventional fighters. The increase in maneuverability also improved survival indicators: The pilot was able to evade his opponent's blows from short range more freely.

Will supermaneuverability change the tactics of one-on-one close combat? Here is the answer foreign military specialists give to this question. All-aspect close combat, which is presently limited by safety considerations in the case of an attack in the forward hemisphere (owing to the great danger of colliding with an opponent turning on a collision course), is becoming a real possibility. When two supermaneuverable fighters come together in combat, instantaneous reaction to the opponent's actions acquires special significance. The transition from a position of low threat, according to present yardsticks, into a sector of effective fire would occur in 2-3 sec. It is emphasized however that such a "leap" in course or pitch is effective only if it is initiated when the airplane already occupies an advantageous position in relation to the opponent. Supermaneuverability, which permits a fast 4-6 degree turn without shifting the trajectory, is intended, as was noted earlier, as a means of achieving the best conditions for aiming and using weapons, and not as a means of maneuvering with the goal of occupying an advantageous position for an attack, since this would result in a premature loss of speed.

Enhancement of Individual Protection

[illegible] factor is directly associated with expansion of the offensive and defensive capabilities of fighters. The history of all forms of armed conflict shows that whenever offensive weapons are improved, defensive resources are immediately developed in response, and therefore, a relative "balance" between them persists.

Western military press turns its attention to the fact that the possibility for launching medium-range missiles that can subsequently guide themselves to a target on their own itself raises the safety of the missile-carrying airplane. If the opposing sides have identical offensive capabilities in combat, the side which loses the fight for time is the one that goes over to defense. In other words the fighter that detects its opponent later is compelled to defend itself. This is the origin of the principle "first to see, first to attack."

While the "first to see" principle of combat is associated with preparation for an attack—that is, with offense, the principle of "keeping from being seen" bears a defensive hue. Even so, the latter principle is also implemented by means of technical and tactical measures. With the advent of medium-range guided weapons, radar search carried on far beyond the zone of visual detection of the airborne enemy assumed the forefront.

At the same time a working onboard radar station reveals the presence of a fighter. But the purpose of a fighter is to annihilate airborne targets—that is, to attack, and not to avoid attack. And an attack with medium-range missiles would be impossible without turning on a powerful emitter—the onboard radar station. Turning it on voids all camouflage and concealment measures—that is, measures to ensure covertness of actions, since the opponent can quickly establish the

presence of a threat by passive sensors. Significant problems arise in aerial combat in this connection, wrote the journal AVIATION WEEK AND SPACE TECHNOLOGY. To maintain concealment, it would be more suitable to equip fighters with passive infrared and thermal-visual guidance systems for guided missiles. Their resolution is higher than that of radar systems, but their use depends on weather conditions. Moreover because of the low range of detection of targets, pilots face the prospect of a return to close fluid aerial combat.

Other measures to enhance individual protection of fighters include reducing the effective area of radar scattering, providing devices that jam enemy detection resources and employing tactics that are most advantageous from the standpoint of concealment.

On the whole, in the estimation of foreign military specialists, changes will occur in aerial combat in the near future in connection with improvements in airplanes and inclusion of new missiles in their armament inventory: The ratio between the quantity of battles fought at medium and long range will change (in favor of the former). However, the basic principles and methods of such combat will remain practically the same.

This article once again demonstrates that in the course of unceasing preparations for war against the USSR and other countries of the socialist fraternity, besides increasing the striking power of their air forces the militaristic circles of the NATO bloc are devoting significant attention to developing the equipment and tactics of fighter aviation, and especially to use of fighters in aerial combat.

11004

Aircraft Cannon

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[Article by Col A. Belov, candidate of technical sciences]

[Text] Abroad, aircraft cannon are given a special place in the armament of warplanes and helicopter gunships. They are indebted for such attention to the following specific properties of aircraft cannon: universality of use—that is, their capability for operating effectively enough against both ground and airborne targets; constant readiness to fire; insusceptibility to electronic countermeasures; slow obsolescence. As an example of the latter assertion, consider the American 20-mm six-barrel Vulcan cannon, designed in the early 1960s and still in the inventory. In all of this time it has not undergone any noticeable design changes.

Despite swift development of guided missiles of different classes, which as a rule are narrowly specialized in relation to the types of targets they hit and the conditions under which they are used, aircraft cannon are maintaining a strong presence, and will continue to do so for a rather long time. At the same time, change in the characteristics of targets, associated chiefly with their greater strength and higher maneuverability, compels foreign designers to seek ways of maintaining the high effectiveness of aircraft cannon in the new conditions.

America's General Electric and McDonnell Douglas, England's Royal Ordnance, West Germany's Mauser, France's Industrial Association GIAT, and Switzerland's Oerlikon are having the most noticeable influence on technical policy in the area of foreign aircraft cannon armament. Each of these companies possesses its own basic cannon designs, to which they adhere even in their new developments, introducing certain improvements into them. The particular features of these designs will be described below following a few general principles.

General Principles. All aircraft cannon are automatic. Automatic fire requires fulfilling the following operations in each cycle: feed (delivery of a round to the receiver), seating (delivery of the round to the chamber), locking (closing the barrel bore at its receiver end), discharge (ignition of the powder charge and acceleration of the projectile in the barrel), and extraction (extraction and removal of the spent shell case). The operations listed above determine the basic parts of the cannon: the feed system; the receiver; the chamber; the barrel; the breech block or locking mechanism, which performs the functions of seating, locking and extraction; the powder ignition mechanism. An automatic cannon is operated by a special system called the power drive. The drive may be internal—that is, utilizing discharge energy, or external, from an outside source.

A few basic characteristics are usually used to describe aircraft cannon: caliber (mm), projectile weight (gm), muzzle or initial velocity of the projectile (m/sec), rate of fire or cyclic rate of fire (discharges per minute), and cannon weight (kg). Composite indicators are calculated to evaluate the sophistication of the design and the technological level of cannons: the projectile's muzzle energy (half the product of the projectile weight and the square of its muzzle velocity), muzzle power (the product of muzzle energy and cyclic rate of fire), and relative muzzle power (ratio of muzzle power to cannon weight).

It is felt that these indicators characterize a cannon as a device for launching projectiles, but they do not fully determine its effectiveness, inasmuch as they do not account for the lethal effect of the ammunition and its external ballistic characteristics. Therefore, the feasibility of a given design of an aircraft cannon is determined at a higher level using the cost/effectiveness (C/E) criterion, calculated by the formula $C/E=AxB/Y$, where A is the probability of target kill, B is technical reliability and Y is reduced cost.

The effect of individual design parameters of cannons upon the components of indicator C/E is discussed below.

Rate of fire: The dependence of kill probability on rate of fire is practically linear at low rates of fire, and weakens somewhat as the rate of fire grows (Figure 1). Therefore, the rate of fire would have to be increased in order to raise the effectiveness of cannons. The cyclic rate of fire depends on the time it takes to carry out the basic operations and on the extent to which they are integrated together. The duration of the operations is limited by the maximum speeds of moving parts participating in the work of the cannon's automatic system, and by the velocities of their collision, which are determined by the mechanical strength of the materials employed. The barrel also makes its mark on these limitations. The thermal conditions, which have a strong influence on the resistance of the barrel to mechanical and erosive effects, are critical to the barrel. To weaken the harmful effects, the barrels are made from materials characterized by high thermal stability, special heat treatment methods are employed, and the inside surface of the barrel is coated with wear-resistant compounds. Given the strength limits that have been attained, the possibility for achieving a high rate of fire is associated with utilizing progressive design concepts that would integrate the basic operations. Aircraft cannon are commonly characterized in three design groups, in which the potentials of the barrel and the locking mechanism are balanced in different ways (Figure 2):

Single-barrel cannon with one chamber—the so-called "classical design"—possess internal power drive utilizing powder gas energy (gas drive) or recoil energy (mechanical drive). The cyclic rate of fire of the latter is limited by the locking mechanism, while the capabilities of the barrel are not utilized completely. A cannon with gas drive permits a higher rate of fire mainly owing to the fact that the total weight of parts involved in the work of the automatic system is lower. It is felt that the potentials of the barrel and the breech block are well balanced in such cannons.

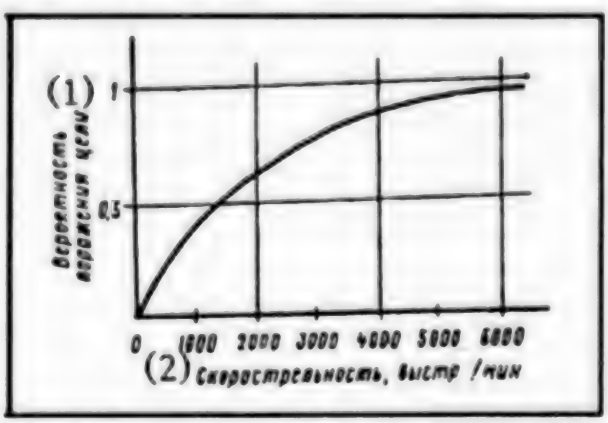

Figure 1. Dependence of the Probability of Target Kill on Rate of Fire (Target Dimensions 0.3x0.3 m, Target Velocity 300 m/sec, Burst Duration 2 sec)

Key:
1. Target kill probability
2. Rate of fire, discharges per minute

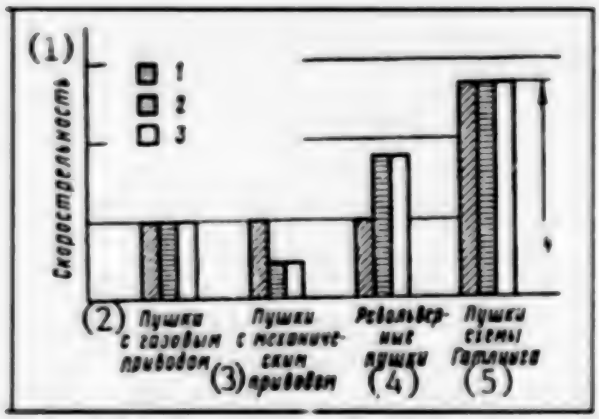

Figure 2. Balance and Potential Rate of Fire of Cannons of Different Designs: 1—maximum rate of fire allowed by barrel; 2—maximum rate of fire allowed by breech block; 3—cannon's effective rate of fire; 4— rate of fire depending on number of barrels and energy of external drive

Key:
1. Rate of fire
2. Cannons with gas drive
3. Cannons with mechanical drive
4. Revolver-type cannons
5. Gatling guns

Revolver-type cannon are distinguished by the fact that one barrel is serviced by several chambers. This design makes it possible to combine several operations together—for example discharge with seating the cartridge into one free chamber and extraction of a shell case from another, and cartridge feed with locking of the bore as the chamber unit rotates. In this case the rate of fire is determined by the speed of the revolver mechanism, and the barrel in such a system is overstressed. An internal gas power drive is usually employed.

Multibarrel cannon with a rotating barrel unit (the Gatling system) are also well-balanced designs; all necessary operations are carried out within one rotation of the barrel unit. It is usually rotated by an external electric drive. The rate of fire of multibarrel systems can be varied within rather wide limits, and it can attain very high values by changing the number of barrels. The Gatling system is typified by one unique feature—relatively long start-up and cease-fire times (around 0.5-1 sec) and a correspondingly lower rate of fire in these phases. This feature is significant in combat conditions. The survivability of cannon of this design is extremely high.

Projectile muzzle velocity: The effect of projectile muzzle velocity upon the probability of target kill manifests itself in two basic directions: reduction of the time of

flight of the projectile to the target (when firing on a target accelerating transverse to the line of fire, the kill probability is approximately proportional to the fourth power of muzzle velocity; Figure 3) and growth of its destructive capability (chiefly growth of the depth of penetration). Given constant caliber, muzzle velocity may be increased by reducing projectile weight (however, in this case the projectile would decelerate faster in the air, and it may not offer any advantage in time of flight at a great range of fire), increasing the weight of the powder charge and raising the power factor of the powder.

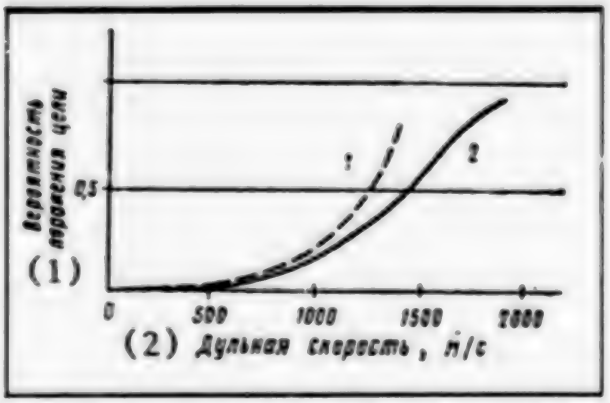

Figure 3. Dependence of Target Kill Probability on Projectile Muzzle Velocity: 1—kill probability is approximately proportional to the fourth power of muzzle velocity; 2—target dimensions 3x3 m, range of fire 2,000 m, 50 projectiles per burst

Key:
1. Target kill probability
2. Muzzle velocity, m/sec

Research on the physical processes associated with acceleration of projectiles showed that any muzzle velocity from 0 to 3,000 m/sec may be attained by varying the weight of the projectile and powder. The effect of very high projectile velocities on the cannon barrel is not yet sufficiently known, and it is felt that a powder charge permissible for practical purposes would be one which imparts a muzzle velocity of around 1,200 m/sec to the projectile.

Caliber: Caliber affects the probability of target kill by way of the destructive effect, which grows as the caliber and weight of the projectile increase. When we take account of its effect on other characteristics of the cannon, the dependence of target kill probability on caliber acquires the form shown in Figure 4, where the maximum of the curve lies in the 30-40 mm range for projectiles with an impact fuse, and at higher calibers for projectiles with a proximity fuse. Accuracy of fire: When it comes to determining accuracy of fire indicators, upon which the probability of hitting the target depends in the final analysis, the ballistic errors of the cannon and ammunition are compounded by sighting errors generated by the weapon control systems. In the opinion of

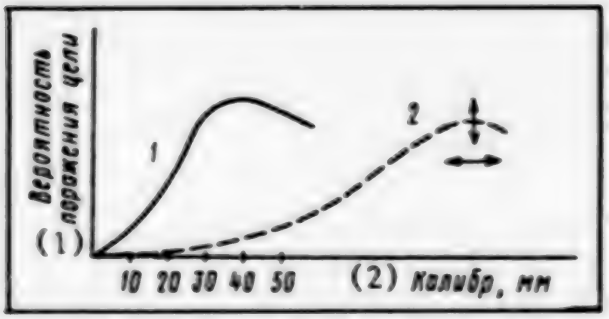

Figure 4. Dependence of Target Kill Probability on Gun Caliber: 1—projectiles with percussion fuses; 2—projectiles with proximity fuses

Key:
1. Target kill probability
2. Caliber, mm

Western military specialists the ballistic dispersal that has been attained with cannons—1 mrad (the standard deviation)—is fully consistent with the accuracy of modern fire control systems. A further increase in ballistic accuracy is not anticipated in the immediate future.

At the same time there are additional possibilities for raising the probability of hitting a target—particularly by using ammunition furnished with proximity fuses or correcting (control) systems. Use of proximity fuses brings two oppositely acting factors into play. On one hand the hit probability increases inasmuch as direct contact with the target is not required, while on the other hand the projectile's destructive action decreases, owing to which weapons of higher caliber become more feasible. As far as creating controllable ammunition for medium caliber cannons is concerned, it is believed that the fundamental possibility for doing so exists, but that such ammunition would be too expensive. Therefore from the standpoint of the C/E criterion, rapid- fire 30-35 mm cannons with uncontrolled impact-action projectiles remain more feasible.

Ammunition feed systems: Ammunition feed systems are subdivided into belt feed systems, in which the cartridges are joined together into a cartridge belt by means of links, and beltless (or link-free) systems, in which the rounds push each other forward and move along guides of various shapes. Belt feed is relatively simple in design, but at the same time it has the shortcoming that it is sensitive to breaking of the belt (links). Such a system is suitable when a low ammunition reserve is maintained. Link-free feed systems are distinguished by considerable diversity—linear, screw, drum, single-track, multitrack and others. As a rule they are developed with regard for the size of a unit of fire and the shape of the space available for it.

Present Status. Aircraft cannon presently in the inventory are represented by 20, 27 and 30 mm caliber models of different designs (their basic characteristics are given in Table 1). Gatling systems and second- generation

(1) Обозначение и наименование пушки, страна-разработчик, год принятия на вооружение	(2) Масса, кг / тип пушки (3)	(4) Калибр, мм (количество стволов) / темп стрельбы, выстр./мин (5)	(6) Начальная скорость снаряда, м/с / дульная энергия снаряда, кДж (7)	(8) Дульная мощность, МВт / удельная дульная мощность, кВт/кг (9)
М39, США, 1954 (10)	81 / револьверная (11)	20 (1) / 1700	1030 / 53	1.5 / 18.6
М61 «Вулкан», США, 1961 (12)	116 / с вращающимся блоком стволов (13)	20 (6) / до 6000	1030 / 53	5.3 / 45.7
Мк11, США, 1968	109 / револьверная	20 (2) / 4200	1000 / 57	3.8 / 35.7
GAU-8/A, США, 1974	335 / с вращающимся блоком стволов	30 (7) / 4200	1050 / 204	14.3 / 43.8
«Аден», Великобритания, 1964 (14)	80 / револьверная	30 (1) / 1200	790 / 81	1.6 / 20.2
ВК-27 «Маузер», ФРГ, 1960 (15)	100 / револьверная	27 (1) / 1700	1025 / 130	3.8 / 36.8
«Дефа-552», Франция, 1957 (16)	80 / револьверная	30 (1) / 1300	820 / 81	1.7 / 21.9
КСА, Швейцария, 1978 (17)	125 / револьверная	30 (1) / 1250	1050 / 204	4.4 / ...

Table 1. Basic Characteristics of Modern aircraft cannon

Key:
1. Cannon serial number and name, developing country, year adopted
2. Weight, kg
3. Type of cannon
4. Caliber, mm (number of barrels)
5. Cyclic rate of fire, discharges per minute
6. Projectile's initial velocity, m/sec
7. Projectile's muzzle energy, kJ
8. Muzzle power, MW
9. Relative muzzle power, kW/kg
10. USA
11. Revolver
12. Vulcan
13. With rotating barrel unit
14. Aden, Great Britain
15. Mauser, FRG
16. Defa- 552, France
17. Switzerland

revolver-type systems are felt to be the best in terms of design sophistication parameters (Figure 5). American warplanes (for example the F-4E, A-7D, F-14, F-15 and F-16) carry the M61 Vulcan 20-mm six-barrel cannon. Its next modification (the M61A1) is carried in the nose of the F-18 Hornet fighter, and its ammunition reserve (570 cartridges) is stored in a drum magazine with significantly smaller dimensions than that of the F-16, which is designed to hold 512 cartridges (Figure 6 [not reproduced]). The Vulcan cannon is rather effective against ground targets.

European-made airplanes are outfitted predominantly with less-cumbersome single-barrel revolver-type cannon of higher caliber—the 30-mm Defa, Aden and KCA, or the 27-mm Mauser. When a high rate of fire is necessary, two cannon are installed in the airplane.

Evaluating the present status of aircraft cannon armament, specialists of Switzerland's Oerlikon imposed requirements on cannon in the order shown in Table 2 in correspondence with the need for hitting airborne and

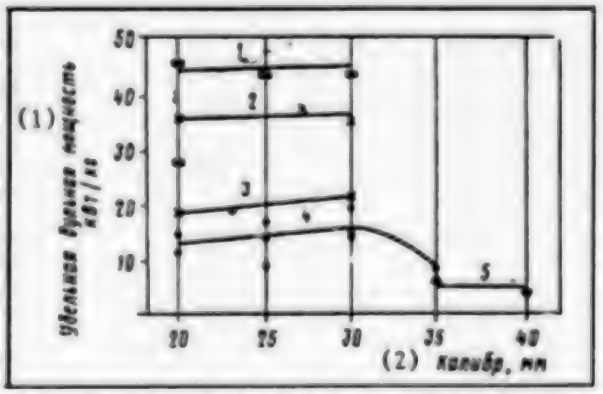

Figure 5. Design Sophistication of Different Systems of Cannon: 1—Gatling guns; 2—second-generation revolver-type cannon; 3—first-generation revolver-type cannon; 4—gas drive cannon; 5—mechanical drive cannon

Key:
1. Relative muzzle power, kW/kg
2. Caliber, mm

ground targets. The intention is to satisfy these requirements in the following manner. A high density of fire should be attained by raising the rate of fire. A high rate of fire is needed against airborne targets owing to the high relative velocities of the airplanes and correspondingly the shorter durations of the bursts. A high initial (muzzle) projectile velocity combined with higher caliber means an increase in the range of fire and reduction of the time it takes for the projectile to fly to the target. Armor-piercing capability is increased by improving the ammunition—for example by using shell cores made from spent uranium or by switching to heavier projectiles. Thus, at a range of 1,000 m, the Swiss 30-mm KCA cannon, which is designed to function with rounds for the American GAU-8/A cannon with a heavier projectile containing a uranium shell core, imparts kinetic energy exceeding the projectile energy of Aden and Defa guns of the same caliber by more than six times. This is what is responsible for its higher effectiveness against both airborne and ground targets, including armored targets.

Fire against airborne targets	Fire against ground targets
Higher density of fire	Higher range of fire
High projectile muzzle velocity	Higher effectiveness of ammunition
Higher effectiveness of ammunition	Reduced time of projectile's flight to target
Higher range of fire	Higher density of fire
Reduced time of projectile's flight to target	

Table 2. Basic Requirements on aircraft cannon

Basic Directions of Development of aircraft cannon by Foreign Companies. In designing its cannon, America's General Electric remains faithful to the Gatling system and to an external power drive. Using the GAU-8/A 30-mm cannon as the basis, this company's specialists have created a four-barrel version—the GAU-13/A (designated the GE430 by the company) with a rate of fire of 2,400 shots per minute to be accommodated in a suspended GPU-5/A cannon mount (pod). The latter is easily installed on light airplanes, making them capable of fighting armored targets on the battlefield. The barrel unit is rotated by compressed air, and only a small quantity of electric power is needed from the airplane to control the cannon's operation. The pod uses a link-free "double helix" cartridge feed system that winds around the cannon itself, as a result of which the cannon can be fitted in an extremely small space.

This company developed the GAU-12/U (GE525) gun mount for the AV-8B fighter. It is equipped with a 25-mm five-barrel cannon weighing 122 kg and characterized by a rate of fire of 3,600 shots per minute and a muzzle velocity of 1,100 m/sec. The GAU-12/U mount is unique in that the cannon and its ammunition are accommodated in two separate pods initially designed for the Aden 30-mm cannon. The cannon occupies the left pod while the ammunition occupies the right, and the link-free feed system is built into a fairing joining the two pods together. The feed system, which has a capacity of 300 cartridges, is designed on the basis of the "ladder" principle: A chain of drive elements moves the cartridges along nonmoving guides.

The company is presently working on cannon armament for a future European fighter, the EFA. Thus an improved version of the Vulcan 20-mm cannon with a longer barrel is being developed. It is oriented on new ammunition with a compacted powder charge and a lightened projectile with improved aerodynamic shape. This makes it possible to raise projectile velocity from 1,030 to 1,200 m/sec, to decrease its time of flight to the target, and thus to widen the range of effective target kill. It is felt that the improved Vulcan 20-mm cannon will be more effective against airborne targets, while the GAU-12/U 25-mm cannon will be more effective against ground targets.

In its AGT (Advanced Gun Technology) program, General Electric is studying the possibility for creating a cannon firing telescopic ammunition. The goal of the development efforts is to arrive at a light and compact weapon with initial velocities of up to 1,500 m/sec. By shortening the cartridge, the plan is to shorten the receiver and make the ammunition feed system smaller and lighter. It is noted in the foreign press that until hopeful results are attained in the AGT program, the improved Vulcan cannon, which promises a significant increment in combat capabilities at relatively low outlays, will be viewed as the basis for designing a cannon for the ATF American tactical fighter of the future.

General Electric is presently developing the GE225 cannon, which is of a completely new type—a double-barrel 25-mm caliber cannon with internal gas drive (Figure 7 [not reproduced]). The barrels are fired alternately, and synchronization is achieved by a twin rocking breech block. This cannon is intended for AH-1 helicopter gunships as a replacement for the M179 20-mm three-barrel cannon.

Besides working to improve aircraft cannon, General Electric is devoting considerable attention to designing link-free cartridge feed systems. It was the first to develop the design of a feed system with a drum magazine, in which the ammunition is stored nose inward, being held against the inner surface by a spiral guide. When the weapon is fired, a feed rotor turns, moving the cartridges along the spiral guide up to the entrance of a belt tube connected directly to the cannon. Spent shell

cases are fed out the other end into drums, where they are collected by the same means. This system is intended for large ammunition loads, and it is used in practically all airplanes equipped with Vulcan cannon as well as in A-10 attack aircraft for storage of the ammunition load (1,350 rounds) of a GAU-8/A 30-mm cannon. The drum feed system has demonstrated its high reliability over many years of operation.

In addition this company has created several versions of a linear link- free feed system intended for a small quantity of ammunition. Such a system may be packed up and deployed in any space within the aircraft structure allocated to it. In particular a system in which each cartridge is held in place and moved by two elements traveling in tracks on rollers has been developed for the American F-15E fighter. The possibility for constantly monitoring the status of the ammunition and the low power required due to absence of friction between cartridges and nonmoving guides are believed to be advantages of such a system.

America's McDonnell Douglas has concentrated its attention on weapons for the Apache AH-64A helicopter, for which the M230 30-mm cannon was designed. A chain drive connected to the helicopter's propulsion unit is used as its external power drive. The cannon design employs a means of converting the turning motion of the chain into the back-and-forth movement of the breech block. Judging from reports in the Western press, the cannon has demonstrated high reliability, economy and simplicity of operation.

England's Royal Ordnance developed a new Aden 25-mm cannon (the Aden-25) for the Harrier-GR.5 fighter. It is a revolver-type cannon with gas drive (Figure 8 [not reproduced]). The possibility for installing it in other airplanes, particularly the Sea Harrier and the Hawk-200 as well as in the planned EFA tactical fighter, is being examined. The standard NATO 25-mm cartridge used in this cannon has a projectile of practically the same weight and dimensions as that of the Aden 30-mm cannon (Aden- 30), but the power of the powder charge is higher. This made it possible to raise the initial velocity of the projectile to 1,050 m/sec and the rate of fire to 1,650-1,850 discharges per minute. Use of a longer and wider shell case and greater maximum gas pressure in the barrel necessitated conversion to a steel (rather than bronze) cylinder for the gas drive mechanism, which created the possibility for making the walls thinner and keeping the dimensions of the cannon the same as those of the Aden-30.

West Germany's Mauser has now produced more than 2,000 models of a revolver-type 27-mm cannon with gas drive (designated the BK-27, Figure 9 [not reproduced]). The Tornado fighter and the Alpha Jet light ground-attack aircraft (see color insert [not reproduced]) are armed with this cannon. Further development of this cannon is directed at raising its working life from 5,000 to 7,500 hours (and to 10,000 hours in the future). The barrel has a life of 2,500 hours, though practical results differ quite significantly from calculations: from 4,000 hours aboard the Alpha Jet to 1,000 hours aboard the Tornado, for which the burst length attains up to 3 sec (70 projectiles).

The foreign press reports that this company intends to propose a new version of the BK-27 for the EFA airplane. It will use ammunition with a plastic driving band, which should be sufficiently elastic, withstand high temperature and resist aging well. It is suggested that use of plastic bands will make it possible to reduce barrel wear by 90 percent. At the same time there are plans for also improving the external ballistic characteristics of the projectile: Initial velocity increases by approximately 6 percent with the same quantity of powder. The version of the cannon for the EFA is also to possess a higher rate of fire, equal to 1,850-1,900 discharges per minute, which will increase the probability of destruction of typical targets.

The company is also working on a link-free cartridge feed system for the EFA airplane. The new cartridges will make it possible to reduce the dimensions and weight of the cannon mount as a whole or increase the ammunition load within the same space, and ensure high reliability and faster reloading. The possibilities for utilizing pneumatic or hydraulic hoists by which to replace ammunition in order to reduce reloading time and decrease labor outlays is being studied.

The BK-27 cannon can fire several types of ammunition of identical dimensions containing armor-piercing, explosive armor-piercing, fragmentation and practice projectiles. Specialists at Mauser prefer high projectile weight and rate of fire over initial velocity, and an electrical fire control system, feeling that it is more precise than a mechanical one within a wide range of temperatures and that modern electric detonators are entirely safe to use.

The French Industrial Association GIAT is modernizing existing cannon systems and creating new models for future warplanes and helicopter gunships. In particular improvements on the Defa-522 30-mm cannon are continuing. The cyclic rate of fire was raised to 1,800 discharges per minute in its subsequent modifications (Defa-553 and -554). Electric fire control in the Defa-554 cannon, with which the French Mirage-2000 fighter is armed, made it possible to attain a rate of fire of 1,100 discharges per minute against ground targets over a long period of time. The cannon has a pyrotechnic reloading system capable of servicing six breech blocks. The length of the receiver is to be increased in the future so that it can accommodate improved ammunition. An initial velocity of about 1,000 m/sec can be achieved with the latter.

Efforts are presently under way to design new 30-mm cannon: a type 781 cannon for the proposed HAP helicopter gunship and a type 791B cannon for warplanes.

The type 781 is a light cannon (weighing 65 kg) of modular design that will make it possible to easily remove and replace parts. It is capable of single-shot fire and fire in bursts at a relatively low rate of fire—750 discharges per minute. When necessary, the rate of fire could be reduced by decreasing the rotation rate of the electric drive. The cannon has a long life and low recoil. It will be installed in the HAP helicopter in a ring mount beneath the nose. Cartridge feed will be from above by way of rather flexible tubes allowing for large angles and high pivoting speed of the cannon.

The type 791B cannon, development of which is to be completed by 1993, is to use new ammunition with an initial velocity greater than 1,000 m/sec. Automatic reloading in response to jamming is foreseen in it. In contrast to preceding developments, the ammunition will be separated from the links prior to it being fed into the cannon, which will eliminate the possibility of jamming or damage to cannon parts. Shell cases are to be collected in a box that is a continuation of the receiver. Elimination of external ejection of shell cases should raise the safety of airplanes during fire.

Switzerland's Oerlikon remains firmly faithful to gas driven designs in its cannon; its specialists feel that this design has a higher potential safety than external-drive systems, inasmuch as the breech block opens in response to a discharge, and it cannot open spontaneously. The company is also working to improve the ammunition. Thus a fuse providing a delay proportional to the target's resistance force was created for destruction of airborne targets. In this case the projectile explodes within the target, thus ensuring the maximum impact. A new armor piercing-fragmentation-incendiary projectile is being developed for use against lightly armored ground targets. Its sturdy head is followed by a section lined by a skin that disintegrates upon penetration to release the precut fragments and incendiary mixture contained inside.

Among the directions of work actively pursued by all foreign companies, the foreign press mentions the search for ways to create fundamentally new ammunition opening up additional possibilities for significantly improving cannon design (shell-less, telescopic, guided and adjustable projectiles capable of proximity detonation), research on new principles of hurling projectiles (liquid propelling substances), and searching for new construction materials in order to lighten various cannon components. Research being conducted abroad indicates that aircraft cannon will continue to occupy an important place within the composition of the weapon systems of warplanes of different kinds, and they will make a noticeable contribution to the effectiveness of these warplanes.

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Status and Basic Directions of Development of NATO Navies

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No 3, Mar 88 (signed to press 5 Mar 88) pp 47-57

[Article by Capt 2d Rank Yu. Kravchenko]

[Text] The present status and prospects of development of American naval forces were demonstrated in the first part of this article (1). The navies of the other NATO countries are examined below on the basis of overt foreign press materials.

Great Britain possesses the largest navy in Western Europe. Counting its reserve, as of 1988 it had 153 warships—4 nuclear-powered missile boats, 15 nuclear-powered and 12 diesel submarines, 3 light aircraft carriers, 13 guided missile destroyers, 27 guided missile frigates, 11 frigates, 16 patrol ships, 42 minesweepers and 10 landing ships, as well as over 200 auxiliary vessels of different kinds. The effective combat strength of naval aviation totalled around 30 Sea Harrier strike fighters, over 170 helicopters (including 120 antisubmarine, around 30 troop-transport, 10 early warning and 16 gunship), and about 160 airplanes and helicopters in auxiliary naval aviation.

Following the removal of Vulcan-B.2 medium bombers from the inventory in 1982, nuclear-powered missile submarines were the country's sole strategic resource. Four "Resolution" class nuclear-powered ballistic missile submarines have now been refitted under the Shevalin [transliteration] program for Polaris-AZTK missiles with a range of up to 4,600 km, equipped with new MIRV multiple warheads with yields from 120 to 600 kilotons. Three submarines are usually kept combat ready while one is undergoing repair and modernization (18-24 months) or combat training (up to 9 months) prior to its return to the combat-ready forces. Ballistic missiles are replaced on an average of every 2 years, and the cruising time of the missile submarines between repairs is around 5 years.

Creation of nuclear-powered ballistic missile submarines of a new generation equipped with Trident-2 ballistic missiles (four in a series) is the principal direction of development of the country's strategic forces. In April 1986 Vickers Ship Building and Engineering in Barrow in Furness received an order to build the prototype "Vanguard", which according to the plan will have a submerged displacement of 15,850 tons, a length of 148.3 m, a width of 12.8 m, a displacement of 12.8 m and a submerged cruising speed of around 25 knots. The submarine is to be armed with 16 American Trident-2 ballistic missiles with English-made MIRV warheads (up to eight individually guided warheads with a range of over 11,000 km). Construction of the "Vanguard" nuclear-powered ballistic missile submarine is expected to be completed in 1993, and it is to be launched in 1994. The average rate of construction of new submarines is to be

kept at one nuclear-powered missile submarine per year. "Resolution" class missile submarines have now been in service for 25-27 years, and they will be gradually phased out. Military specialists of Great Britain feel that "Vanguard" class missile submarines could remain operational until the 2020s.

Significant attention is being devoted to raising the combat capabilities of submarines in the general-purpose forces. Measures implemented in this direction foresee further growth of the number of nuclear-powered multipurpose submarines and qualitative renovation of diesel-electric submarines.

The S90 "Torbay" nuclear-powered submarine—the fourth of the "Trafalgar" class—was introduced into the navy in February 1987; another three submarines of this series are in different stages of construction, and they are to be transferred to the navy by 1990. Following their construction, the British navy will possess 18 nuclear-powered multipurpose submarines (seven "Trafalgar" class, six "Swiftsure" class and five "Valiant" class) (2).

Twelve "Oberon" class diesel submarines presently in the inventory, nine of which are undergoing modernization, will gradually be replaced by "Upholder" class boats (Project 2400) (3). The prototype submarine was launched in December 1986, and another three are under construction in building berths. There are to be 10 boats in the series.

Three light "Invincible" class aircraft carriers and destroyer and frigate-type escort ships (52 units) make up the backbone of the navy's surface forces.

Considering the experience of combat operations in the vicinity of the Falkland (Malvinas) Islands, there are plans for modernizing the aircraft carriers R05 "Invincible" and R06 "Illustrious" and for raising their combat capabilities to those of the R07 "Ark Royal." The former will undergo overhaul and modernization beginning in March 1986; in its course, the slope of the ramp will be increased from 7° to 12°, and Goalkeeper antiaircraft artillery systems and new weapon control systems, radar and sonar will be installed. It is anticipated that the work will continue into the middle of the current year. The typical composition of a carrier-based air group will include up to eight Sea Harrier strike fighters, nine antisubmarine helicopters and three AWACS helicopters.

Following completion of the series of "Sheffield" class guided missile destroyers (a total of 14 units were built in 1976-1985; two were sunk during the Anglo-Argentine conflict), construction of more ships of this class is not foreseen for the moment. The principal direction of development of the navy's escort forces is the construction of guided missile frigates. "Broadsword" class ships are presently being transferred to the navy: nine units among the effectives and five under construction (completion of the series is planned by 1990). In addition four "Norfolk" (4) class guided missile frigates were laid down in 1985-1987 (type 23, Figure 2). The total number of ships has not been finally determined.

The naval command feels that the quantitative composition of escort forces should be maintained at a level of 65 units, with regard for having 20 percent of the ships in reserve. Therefore transfer of new ships from industry to the navy will proceed in parallel with transfer of destroyers and frigates that have attained their maximum life (25 years) into the reserves or their demolition.

Ships of the minesweeping forces were significantly renewed in recent years. Last year the last minesweeper of the "River" class (a series of 12 units with a full load displacement of 890 tons, Figure 3) was transferred to the fleet, and the program for building "Brecon" class minehunters (13 units, 725 tons) is nearing completion. In August 1985 the company Vosper-Thornycroft was awarded an order to build a prototype minehunter of the "Sundown" class with a standard displacement of 450 tons (Figure 4). Its transfer to the navy is expected in 1989. Concurrently with this, obsolete "Ton" class ships are being retired into the reserve.

Great Britain's amphibious naval forces include two L10 "Fearless" and L10 "Intrepid" helicopter assault landing ships, six tank landing ships and two small assault landing ships.

Efforts are under way to raise the combat capabilities of naval aviation. Modernization of Sea Harrier-FRS.1 strike fighters presently in the inventory has begun, and it is to be completed in the early 1990s. The modernized airplanes (the modification is termed the FRS.2) will be armed with AIM-120A air-to-air guided missiles, and possibly Sea Eagle antiship missiles, as well as with more up-to-date onboard equipment, including new radar. In the near future, Sea King-HAS.2 and -5 antisubmarine helicopters are to be replaced by new EH-101 craft developed jointly by Great Britain and Italy; there are plans for purchasing around 50 units. A new modification of the Sea King helicopter (the HAS.6), which together with the EH-101 and the Lynx-HAS.2 and -3 will make up the backbone of the antisubmarine helicopter fleet, is expected to enter the navy in 1989. The number of Sea King-HC.4 troop-carrying assault helicopters continues to increase.

Federal Republic of Germany. The FRG possesses rather powerful naval forces. According to "Jane's Fighting Ships" they have not undergone significant changes in the last few years, and they have a strength of almost 200 warships and launches, including 24 diesel submarines, 7 guided missile destroyers, 6 guided missile frigates, 3 frigates, 5 corvettes, 22 small assault landing ships (including 1 training ship and 2 in reserve), 59 minesweepers (including 2 minelayers), 40 missile boats, 28 landing boats (in reserve) and over 100 auxiliary vessels. Naval aviation includes around 120 airplanes and helicopters.

The effective combat strength of submarine forces (18 type 206 submarines and 6 type 205 submarines) will apparently not change in the next few years. Construction of submarines of a new type (211), it is reported in the foreign press, is being postponed for the moment. There are plans for beginning overhaul and modernization of the first six type 206 submarines, which will be designated 206A. Older submarines (type 205) that have been in the inventory since the late 1960s will be gradually phased out of the fleet's effectives at the start of the next decade.

Construction of another two guided missile frigates has now begun—the seventh and eighth in the series of "Bremen" class frigates (type 122, Figure 5). The F213 "Augsburg" was laid down at Bremer Vulcan's building ways in Bremen in March 1987, and the F214 "Lubeck" is being built by Tissen Nordseewercke in the city of Emden. After these ships are transferred to the navy, "Koln" class frigates will be retired from the inventory. The question as to the final number of "Bremen" class ships in the series remains open. Some military specialists suggest the idea that it might be suitable to continue their construction (with some changes) rather than activating efforts to create a so-called "standard frigate of the 1990s" on a multinational basis within the NATO framework, and to develop a new design of a ship of this class capable of their defense (type 124).

Three "Lutjens" class guided missile destroyers (built in the USA in 1969-1970) underwent overhaul and modernization. It is expected that "Hamburg" class guided missile destroyers (four units, 1964-1968) will remain in the inventory following limited modernization until the early 1990s.

The West German navy possesses the largest minesweeping forces of the capitalist navies. As of the beginning of 1988 these forces included 2 minelayers ("Sachsenwald" class, transferred to the navy in 1969), 12 minehunters ("Lindau", 1958-1960), and 6 Troika minesweeping control system ships ("Lindau", 1958-1959), 39 inshore minesweepers (21 "Schutze", 1959-1962, 10 "Frauenlob", 1966-1969, 8 "Ariadne", 1961-1963). The combat capabilities of minesweeping forces is to be maintained at a sufficiently high level by significantly renewing the ship fleet while concurrently retiring obsolete minesweepers into the reserve or dismantling them.

Construction of a series of 10 new type 343 fast minesweepers that are to replace "Schutze" class inshore minesweepers has begun. There are plans for completing the program by 1991. Ships of this type with a full load displacement of around 600 tons were specially designed for operations in the Baltic Sea, and they are intended for two basic missions—laying minefields (they can carry up to 60 mines, and their top speed is 24 knots) and sweeping for mines laid by the enemy.

In the first half of this year construction of Type 332 minehunters is to begin on the basis of Type 343 minehunters (the hull and propulsion unit are similar, but the displacement is somewhat lower). Ten such ships are to be ordered from industry initially. They will be equipped with mine-seeking sonar and with Penguin-B3 cable remote-controlled submersibles for classification and destruction of mines (diving depth 100 m, radius of action up to 1,000 m, independent operating time 2-3 hr). When combat activities begin, minehunters will carry out the missions of mine defense on North Sea lines of communication.

The West German navy still possesses 40 missile boats (10 each of Types 143 and 143A and 20 type 148). Information concerning development of a Type 143B boat has appeared in the foreign press. The series is to consist of up to 20 units. However, detailed information on this is absent.

The FRG is building three new type 423 reconnaissance ships (Figure 6). The prototype, the A50 "Oste", was commissioned in September 1987. The ship's displacement is 2,400 tons, its length is 83.5 m, its width is 14.6 m, its draft is 9.4 m, and its speed is 19 knots.

In naval aviation, rearmament of the 1st and 2d squadrons with Tornado airplanes is nearing completion. They replaced F-104G fighter-bombers and RF-104G Starfighter Scouts. A total of 112 aircraft were ordered for the country's navy. A contract was signed with Great Britain to deliver five Lynx ship-based antisubmarine helicopters to supplement the 12 existing in the navy beginning in July 1988.

France The French navy possesses 124 warships (6 nuclear-powered missile submarines, 4 nuclear-powered multipurpose submarines and 14 diesel- powered submarines, 2 aircraft carriers, a guided missile cruiser and a helicopter-carrier cruiser, 15 guided missile destroyers, 2 destroyers, 24 guided missile frigates, 1 frigate, 17 landing ships, 27 minesweepers and 10 patrol ships). The navy's light forces include 3 missile and 12 patrol boats; a possibility for installing Exocet antiship missile systems was foreseen for 10 Type P-400 boats. Naval aviation possesses over 150 warplanes and helicopter gunships.

Six nuclear-powered missile submarines—five "Redoubtable" class and one "Enflexible" class (S615)—are organizationally included in the strategic naval command. As a rule four boats are combat ready while two are undergoing overhaul and modernization at the Cherbourg docks.

The S614 "Le Tonnant" and S615 "L'Inflexible" nuclear-powered ballistic missile submarines are armed with M4 ballistic missiles with a range of around 4,500 km equipped with MIRV warheads (six individually guided warheads of 150 kilotons each), while the rest are equipped

with M20 ballistic missiles with a single 1 megaton warhead. Another two submarines (S612 "Terrible" and S613 "L'Indomptable") are now being refitted with M4 missiles. After this, the nuclear-powered ballistic missile submarine S610 "Le Foudroyant" is to be refitted. The work is to be completed by 1992. There are no plans for rearming the S611 "Le Redoubtable", since it will be retired into the reserve in the mid-1990s. All French nuclear-powered missile submarines are to be armed with SM-39 Exocet antiship missiles with a range of around 50 km, which will be launched out of 533-mm torpedo tubes. "Le Redoubtable" class nuclear-powered missile submarines will remain among the effectives until the year 2000.

Industrial orders for a new type of nuclear-powered ballistic missile submarine are anticipated in correspondence with the plan for development of the country's armed forces in 1984-1988. This submarine is to be transferred to the fleet in 1994. Its submerged displacement is 14,200 tons (its surface displacement is 12,700 tons), its length is 138 m, and its width is 12.5 m. Initially it will be armed with 16 improved M4 ballistic missiles, and later on with new M5 missiles with a range of up to 6,000 km.

France is continuing construction of nuclear-powered multipurpose submarines of the "Rubis" class (a series of seven units). Three nuclear-powered submarines—the S601 "Rubis", the S602 "Saphire" and the S603 "Casablanca"—are among the fleet's effectives; transfer of a fourth to the navy is anticipated in the near future, two are still under construction, and one has been ordered. The design of the last three submarines will be altered somewhat. They are intended chiefly for antisubmarine missions. Besides nuclear-powered submarines, the regular navy includes 14 diesel submarines (four "Agosta" class, nine "Daphne" class and one experimental submarine—the "Narval"). It is anticipated that "Daphne" class submarines will be retired into the reserve or dismantled in the next 10 years as nuclear-powered submarines enter the fleet, while "Agosta" class submarines will remain in operation until 2005-2010. Besides torpedoes, "Rubis" and "Agosta" submarines are armed with Exocet antiship missiles.

An order for construction of the country's first nuclear-powered aircraft carrier was placed in February 1986. It is to be laid down at the building docks of the naval arsenal in Brest next year, and it is to be transferred to the navy by 1996. According to the plan it will have a full load displacement of around 36,000 tons, a length of 261.5 m, a width of 31.8 m (the flight deck is to be 64.4 m wide) and a draft of 8.5 m. The aircraft carrier will be able to support the combat operations of up to 40 deck-landing airplanes (with a take-off weight up to 20 tons) and helicopters. It will initially be used as a base for Super Etandard strike fighters. The second aircraft carrier will possibly be ordered in 1990. The French naval command believes that the carriers R98 "Clemenceau" and the R99 "Foch" will remain in the inventory correspondingly until 1995 and 1998.

Renewal of the surface fleet is proceeding along the lines of building new guided missile destroyers and frigates and removing obsolete classes of ships from the naval register.

Construction of a series of seven "Georges Leygues" class guided missile destroyers (Figure 7) with reinforced antisubmarine armament is presently nearing completion: Six ships have already been transferred to the navy, and it is anticipated that the last will be commissioned in 1990. In the first half of this year the fleet will receive the destroyer "Cassard" (there will be a total of four ships in the series), intended chiefly for antisubmarine missions. The ships "Georges Leygues" and "Cassard" were designed on the basis of the same hull, and they are distinguished, besides by different weapons systems, by the silhouette of the superstructure and the type of propulsion unit (the "Georges Leygues" has a combined diesel and gas turbine system, while the "Cassard" has a diesel propulsion unit). The armament of guided missile destroyers is distinguished by a rather high level of standardization (5).

Allocation of money for construction of new type FL25 guided missile frigates with a full load displacement of 3,000 tons is anticipated in 1988 (6). The number of ships in the series has not yet been determined; the plan is to order three initially. Two variants of the future ships are possible depending on their purpose—with reinforced antisubmarine armament, and multipurpose. Their acceptance by the navy is anticipated in the first half of the 1990s. Gradual retirement of "Commandant Riviere" class guided missile frigates, built in 1962-1965, from the regular navy has begun, and it is to be completed by 1993.

Sufficient attention is being devoted to developing amphibious and minesweeping forces. The helicopter landing ship L9011 "Foudre" (type TCD90) has been under construction since 1986. It is the prototype of a series of three units (full load displacement 11,000 tons, a landing force capacity of 470 marines together with attached combat equipment, 4 Super Puma helicopters and up to 10 CTM landing craft) (7). The landing ship dock "Bougainville" (full load displacement 4,800 tons, accommodates up to 500 assault troops) was transferred to the navy in late 1987.

The minesweeping forces are being updated by the delivery of "Eridan" class minehunters to the navy ("Tripartite" type, 10 units in the series, 8 have already been transferred to the navy). They are replacing former American "Aggressive" minesweepers; it is anticipated that the latter will be completely excluded from the naval registry by 1991. There are plans for laying down a series of new BAMO class minehunters with a full load displacement of 900 tons each (15 units). The prototype is to join the navy in 1990.

As of 1987 naval aviation has been receiving new Atlantic-2 patrol aircraft; a total of 27 units will be delivered.

Italy As of the beginning of 1988 Italian naval forces possessed 74 warships, to include 9 diesel submarines, the light aircraft carrier "Giuseppe Garibaldi", 3 guided missile cruisers, 4 guided missile destroyers, 12 guided missile frigates, 4 frigates, 9 corvettes, 3 landing ships, 29 minesweepers, 7 hydrofoil missile boats and over 100 auxiliary vessels and boats of various purposes.

Two "Sauro" class diesel submarines (modernized variant) are being completed at sea in accordance with the ship building program. It is anticipated that they will join the fleet prior to 1989. Taking them into account, the Italian navy should have 10 submarines by 1990: Six modern "Sauro" class (built 1979-1988) and four "Toti" class. The submarine "Romeo Romei" (1952, former American "Tang" class), which is presently used as a training submarine, will be dropped from the navy. The naval command feels that to carry out its missions, it must have 12 diesel submarines. Preparations for construction of new submarines with a displacement of around 2,000 tons are being completed for this purpose; in this case the prototype is to be laid down in the building docks in the late 1980s or early 1990s.

Two "Animoso" class guided missile destroyers (D560 "Animoso" and D561 "Ardimentoso") have been under construction since March 1986 (8). They are to replace the guided missile destroyers D570 "Impavido" and D571 "Intrepido" built in the first half of the 1960s. The new ships, which possess rather powerful armament (an antiship missile system and two antiaircraft missile systems, one 127-mm and three 76-mm artillery mounts, two 324-mm triple-tube torpedo launchers, two helicopters, (Figure 8)) are to be used in addition to "Maestrale" class guided missile frigates together with the light aircraft carrier "Giuseppe Garibaldi." "Animoso" class guided missile destroyers are to be transferred to the navy in 1990.

The program for construction of "Minerva" class corvettes is continuing (8). The navy possesses two such ships, and another two will be commissioned in the near future, while four were ordered from industry in January of last year. Construction of "Cassiopeia" class escort ships intended to protect the economic zone in peacetime is to begin soon (full load displacement 1,360 tons, armament—one 76-mm and two 20- mm artillery mounts, cruising range 5,000 nautical miles at 15 knots).

The L9892 "San Giorgia" helicopter landing ship dock has been transferred to the navy. Its full load displacement is 7,665 tons, its length is 118 m, its width is 20.5 m, its draft is 5.3 m, its top speed is around 20 knots, its cruising range is 7,500 nautical miles (at 16 knots), and its assault force capacity is 400 marines and 36 armored personnel carriers. An assault landing force can be landed ashore both by transport helicopters (one heavy or three medium) and by means of landing craft (up to six units). Construction of the second ship in the series is planned to be finished this year. Two obsolete tank landing ships (former American "Desoto County" class ships built in 1957) with an assault force capacity of up to 23 medium tanks and 550 marines will be retired from the regular navy.

Significant changes did not occur in naval aviation in 1986-1987. Introduction of new EH-101 antisubmarine helicopters into the inventory is anticipated in the early 1990s. There are plans for initially acquiring around 40 such aircraft. Replacement of shore-based Atlantic patrol aircraft is not planned for the moment: They will be modernized with the purpose of raising their combat capabilities and increasing their life.

On the whole, development of Italian naval forces will be characterized in the next few years by qualitative improvement of the ship inventory while maintaining the number of ships constant.

Canada As of the beginning of 1988 the country's naval forces possessed 26 warships—3 submarines, 4 destroyers, 19 frigates (3 of them in the reserve), and around 50 auxiliary vessels and boats. Thirty-three shore-based patrol aircraft and 32 antisubmarine helicopters organizationally within the navy are used in the interests of the fleet.

Modernization programs were adopted and are now being implemented (or have already been completed) with the goal of lengthening the life of the ships and maintaining them at a sufficiently modern level.

"Ojibwa" class submarines, which are identical to English "Oberon" submarines (built in 1965-1968 in Great Britain), already underwent modernization in 1980-1986. A new American torpedo fire control system and more up-to-date sonar apparatus were installed in them. The submarines are armed with Mk48 torpedoes, and they are capable of launching Harpoon antiship missiles. Their life was increased to the early 1990s.

A program to modernize "Iroquois" class destroyers is beginning, and it should be completed by 1992. After this, the ships will basically carry out the missions of providing air defense to task forces and convoys at sea. It is anticipated that their life will be increased to 2000-2004 (9).

A program to modernize frigates with the purpose of increasing their life by 8-12 years is nearing completion. The following frigates are to be retired in the indicated years (the class and number are shown): "Annapolis" (2)—1994-1996, "Mackenzie" (4)—1990-1993, "Restigouche" (4)—1991-1994. Six "St. Laurent" class ships will be dropped from the naval registry prior to 1990.

The command of the Canadian navy feels that the present status of the fleet would not allow the fleet to carry out its missions well by the early 1990s. Replacement of obsolete diesel submarines by more modern ones, and possibly ones with nuclear propulsion units, is being considered in this connection. Judging from reports in the foreign press, Canada intends to have 10-12 nuclear-powered multipurpose submarines in its

navy by 2005-2010. Plans of English "Trafalgar" class and French "Rubis" class nuclear-powered submarines are being studied as probable prototypes. The new nuclear-powered submarines will be armed with Mk48 torpedoes, Harpoon antiship missiles and mines.

A series of "Halifax" guided missile frigates (six units) are under construction at Canadian building docks. The program is to be completed in 1992. After this, another six ships of this design may be built. A decision wasmadeto replace CH-124 Sea King antisubmarine helicoptersbyEH-101 helicopters. Canada plans to purchase around 35 such craft in the antisubmarine variant.

Foreign military specialists note the absence of minesweepers in the fleet as a significant shortcoming of the Canadian navy. Six former minesweepers with a total displacement of 470 tons are now being used as training and escort ships. Construction of new minesweepers is planned.

The numbers of ships in the navies of other European NATO countries are shown in the table.

Класс корабля (1)	Бельгия (2)	Нидерланды (3)	Норвегия (4)	Дания (5)	Греция (6)	Турция (7)	Испания (8)	Португалия (9)
Дизельные подводные лодки (10)	—	5 (4)[1]	11 (6)	7[1]	10	17	8	3
Авианосцы (11)	—	—	—	—	—	—	1 (1)	—
Эскадренные миноносцы УРО (12)	—	—	—	—	—	2	—	—
Эскадренные миноносцы (13)	—	—	—	—	14	12	0	—
Фрегаты УРО (14)	4	16 (4)	5	5	2	2 (2)	13 (2)	(2)
Фрегаты (15)	—	—	—	5	5	4	—	17
Корветы (патрульные корабли) (16)	—	—	15	—	—	—	8	—
Десантные корабли (17)	—	—	7	—	13 (5)	41	0	3
Минно-тральные корабли (18)	29 (5)	24 (2)	12	13	16	33	12	4
Ракетные катера (19)	—	—	38	10	16	14	—	—
Торпедные катера (20)	—	—	8	6	6	5	—	—
Сторожевые катера (21)	—	—	2	30 (15)[3]	9 (2)	30	30	18
Десантные катера (22)	—	11 (9)	—	—	10	33	30	13
Всего (23)	33 (5)	56 (19)	98 (6)	76 (15)	101 (7)	193 (2)	120 (3)	58 (2)

(24) [1] В скобках (здесь и далее) дано количество строящихся кораблей, а также тех, на постройку которых размещены заказы.
(25) [2] В том числе три подводные лодки проекта 207, закупленные в Норвегии.
(26) [3] Катера проекта «Стандарт флекс 300».

Ship Strength of the Navies of European NATO Countries (Less Great Britain, the FRG, France and Italy)

Key:
1. Ship class
2. Belgium
3. Netherlands
4. Norway
5. Denmark
6. Greece
7. Turkey
8. Spain
9. Portugal
10. Diesel submarines
11. Aircraft carriers
12. Guided missile destroyers
13. Destroyers
14. Guided missile frigates
15. Frigates
16. Corvettes (patrol ships)
17. Landing ships
18. Minesweepers
19. Missile boats
20. Torpedo boats
21. Patrol boats
22. Landing craft
23. Total
24. The number of ships under construction and of those for which construction orders have been placed are in parentheses (here and subsequently)
25. Including three type 207 submarines purchased in Norway
26. "Standard Flex 300" type launches

Beldgium The national naval forces are made up chiefly of minesweepers, the overwhelming majority of which (24 units) were built in the late 1950s. The navy recently received five new "Aster" minehunters ("Tripartite" type), and another five are in different stages of construction or have been ordered from industry. The program is to be completed by 1992. The issue of building another series of minesweepers jointly with the Netherlands, and possibly with Norway, in the 1990s is being studied.

The other principal direction in development of the fleet's forces will be continued modernization of four "Wielingen" class guided missile frigates—in particular, installation of Goalkeeper close-range seven-barrel 30-mm antiaircraft artillery systems (with a total rate of fire of 4,200 rounds per minute).

The Netherlands The fleet is being maintained at the level of modern requirements by means of a 10-year ship building program (1979-1988). The composition of submarine forces should be renovated soon. Four "Walrus" class submarines are being built at the docks in Rotterdam. Transfer of the prototype submarine, the S802 "Walrus", to the navy is being postponed in connection with a fire that occurred in August 1986. The fourth submarine of the series is to be commissioned in the first half of 1993. It may be that another two submarines of this design will be built. "Dolfijn" class submarines built in the early 1960s will be gradually retired into the reserve, and in general, the submarine forces are to be maintained at a level of six boats.

Construction of four "Karel Doorman" (type M) multipurpose guided missile frigates is continuing; the work is to be completed prior to 1993. Another four are on order. Besides the Harpoon antiship missile system, these ships are to be outfitted with a vertical-launching 16- shaft system for Sea Sparrow antiaircraft guided missiles. In the early 1990s the navy will possess a rather powerful and up-to-date escort force consisting of 18-22 guided missile frigates.

Much attention is being devoted to improving minesweeping forces, which is also typical of other European NATO countries. Construction of a series of minehunters in the "Alkmaar" class (15 units in the "Tripartite" program) is close to completion. The navy will receive the last two ships in 1989. It is believed that a new class of minesweeper will be ordered in 1988 or 1989.

Modernization of P-3C Orion shore-based patrol airplanes is expected to begin in 1988-1989.

Norway Construction of six new type 210 submarines in the FRG and modernization of submarines presently in the inventory are the priority directions in the fleet's development. The prototype submarine, the S300 "Ula", was laid down in January 1987 in Emden (the work is to be completed in the first half of 1989). The last submarine will be transferred to the navy prior to 1993. The basic combat characteristics of submarines of this class are: submerged displacement 1,300 tons, length 59 m, width 5.4 m, draft 4.6 m, submerged speed 23 knots, surface speed 11 knots; armament—eight forward 533-mm torpedo tubes (a unit of fire consists of 14 torpedoes). A decision was made to modernize "Kobben" class submarines with the purpose of lengthening their life; three of them have been sold to Denmark.

A program for modernizing five "Oslo" class guided missile frigates is being implemented. They are being equipped with new keel-mounted and towed sonar stations, a fire control system and other electronic equipment. The program will be completed by 1990. Modernization of the fire control system of "Storm" class missile boats (18 units) is to be completed by the late 1980s; the fire control systems of six "Snogg" class missile boats are to be modernized subsequently. Later on they are to be replaced by 24 boats of a new type.

A decision was made to build 10 new minesweepers at the beginning of next year, to include six minesweepers and four minehunters. They were specially designed for action in Norway's coastal rocky areas. According to the plan, the displacement of the new ships will be around 360 tons, their length will be 54.5 m, their width will be 13 m, their draft will be 2.3 m, and their speed will be up to 20 knots. Construction of the series is to be finished in 1996. These vessels will replace eight "Sauda" class coastal minesweepers (former American "Adjutant" minesweepers built in 1954-1955).

P-3B Orion shore-based patrol airplanes will be replaced by new P-3C aircraft, an agreement for the delivery of which was reached with the USA.

Coastal artillery units are beginning to receive 120-mm guns produced by Sweden's Bofors (series ERSTA, rate of fire 25 rounds per minute). The guns are aimed by radar, laser and television systems.

Denmark The naval forces acquired three Norwegian "Kobben" class (type 207) submarines. They are presently undergoing modernization in Bergen; it is to be completed by the early 1990s. By this time two "Delfinen" class submarines, built in 1959 and 1964, will be retired from the inventory.

A program to build a rather large series (16 units) of "Standard Flex 300" boats with a displacement of around 300 tons is presently under way. A possibility for accommodating different armament on the same standard hull depending on the missions is foreseen. The boat can be used as a minelayer, a minesweeper, a missile boat or a torpedo boat. The refitting time averages from 24 to 48 hours. The prototype boat was transferred to the navy at the end of last year, and in the future the rate of construction is to be maintained at two units per year. The foreign press reports that their peacetime function will be to patrol in the straits zone of the Baltic Sea.

Preparations are being made for construction of four new frigates with a displacement of 2,000 tons to replace "Hvidbjornen" class ships.

Greece The issue of building four guided missile frigates is still being studied. It is expected that one will be built abroad, while the others will be built at national docks. The following ship designs are considered to be possibilities: the West German MEK0200, the Italian "Lupo", the American "Superior" and the English modernized "Amazon" or "Linder."

The prototype of a series of five tank landing ships was laid down in April 1987. Its full load displacement is 4,400 tons, its length is 114 m, its width is 15.3 m, its draft is 3.3 m; the 10,400 horsepower diesel propulsion unit can generate a speed of up to 17 knots. The ship has a helicopter pad, and it may take four type LCVP landing craft aboard.

Turkey Construction of the sixth type 209 West German submarine has been completed. There are plans for raising the total number of modern submarines to 12 units in the future. They will replace obsolete "Balao" (ex-American) submarines, refitted in the GAPPI [not further identified] program.

Development of surface forces is proceeding along the lines of building "Yavuz" class guided missile frigates (type MEK0200; two have been commissioned and two are nearing completion in Turkey with the technical assistance of specialists from the FRG), landing ships and missile and patrol boats, and modernizing ships presently in the inventory. Thus there are plans for arming part of the "Gearing" class destroyers (transferred by the U.S. Navy to the Turkish fleet in 1971-1982) with vertical launch shafts for Sea Sparrow antiaircraft guided missiles.

The issue of replacing S-2A and Sea Tracker shore-based patrol aircraft (around 20 units) by American P-3C Orion aircraft and arming nine AB.204B and AB212ASW helicopters with English-made Sea Skua antiship missiles with a range of up to 22 km is being studied.

Spain Transfer of the light aircraft carrier "Prince Asturian" to the navy is anticipated in the first half of this year; the obsolete aircraft carrier "Dedalo", built in 1943, will be dropped from the inventory subsequently. The regular navy has received two "Oliver H. Perry" class guided missile frigates (four in the series; one more may be ordered). They are being built in Spain under an American license.

The ship building program foresees commissioning the following by 1996: three submarines of a new design, one or two guided missile destroyers with a displacement of 6,500 tons, five frigates, including guided missile frigates, four minehunters and eight coastal minesweepers, a helicopter dock landing ship and four tank landing ships, three patrol ships, six missile boats, a cargo transporter and a general-purpose supply transporter. The main attention will be devoted to building submarines (type S80, with French design participation) and "Descubierta" class guided missile frigates, and to purchasing deck-landing AV-8B Harrier strike fighters and helicopters. The first three airplanes of 12 ordered from the USA have already entered the naval aviation inventory.

Portugal An order for construction of three type MEK0200 guided missile frigates in the FRG was placed in July 1986. Two antisubmarine helicopters (of as yet unknown type) will be based on them. Their transfer to the navy is anticipated prior to 1992.

There are plans for modernizing frigates presently in the inventory. Thus the forward 100-mm artillery mounts on "Comandante Joao Belo" class ships are to be replaced by a helicopter pad and hangar for a helicopter (for two helicopters), and by antiship missile launchers (also two). The frigates "Baptista de Andrale" and "Joao Coutinho" (10 units) are to be armed with Sea Sparrow antiaircraft missile systems and antiship missile systems.

Obsolete "S. Roque" class coastal minesweepers built in 1956-1957 are to be replaced by six new minesweepers; construction of the latter is to begin after completion of the program of construction of type MEK0200 guided missile frigates.

The information presented above shows that these are the basic directions in development of the navies of NATO bloc countries: growth and improvement of sea-based nuclear missile forces (USA, Great Britain and France); maintenance of general-purpose forces at a modern level, including construction of new ships and modernization of those presently in the inventory; extensive introduction of missile weapons and other modern weapon systems and electronic resources into the navies; enhancement of the role of naval aviation; close coordination in the development and implementation of national ship building programs.

All of this confirms the aggressive orientation of imperialist policy and the reluctance to reckon with the positive changes occurring in the world, achieved mainly owing to the enormous efforts of the Soviet Union and other countries of the socialist fraternity.

Footnotes

1. For the beginning of the article, see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 2, 1988, pp 57-64.—Editor.

2. For details on English nuclear-powered submarines, see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 4, 1988, pp 54-58.—Editor.

3. For information on the submarine "Upholder", see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 1, 1985, pp 81-82.—Editor.

4. For information on English "Norfolk" class guided missile frigates, see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 2, 1987, pp 69-72.— Editor.

5. For information on French guided missile destroyers, see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 8, 1986, pp 52-56.—Editor.

6. For greater detail on the type F1.25 type guided missile frigate, see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 9, 1987, pp 76-77.—Editor.

7. For information on the new French helicopter dock landing ship, see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 5, 1986, pp 76-77.—Editor.

8. For information on new Italian guided missile destroyers, see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 11, 1986, p 76. For information on the Italian navy's new corvette, see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 11, 1985, pp 77-78.—Editor.

9. For information on the program for modernizing destroyers of the Canadian navy, see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 1, 1987, pp 92-93.—Editor.

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Marine Infantry Battalion Equipped with Fighting Vehicles

18010337i Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian
No 3, Mar 88 (signed to press 5 Mar 88) pp 57-58

[Article by Capt 2d Rank A. Aleksandrov]

[Text] When it comes to implementing practical measures directed at raising the combat capabilities of American marine infantry, the American command attaches great significance to raising the mobility of marine ground forces and their capabilities for fighting the enemy's highly mechanized formations.

For these purposes one battalion equipped with LAV fighting vehicles has been formed in every marine infantry division. It is armed with 149 LAV fighting vehicles of different types, including 56 infantry fighting vehicles, 27 self-propelled guns, 8 command-and-staff vehicles, 16 self-propelled antitank missile systems, 12 antiaircraft self-propelled guns, 8 self-propelled mortars, 6 recovery vehicles and 16 transport vehicles.

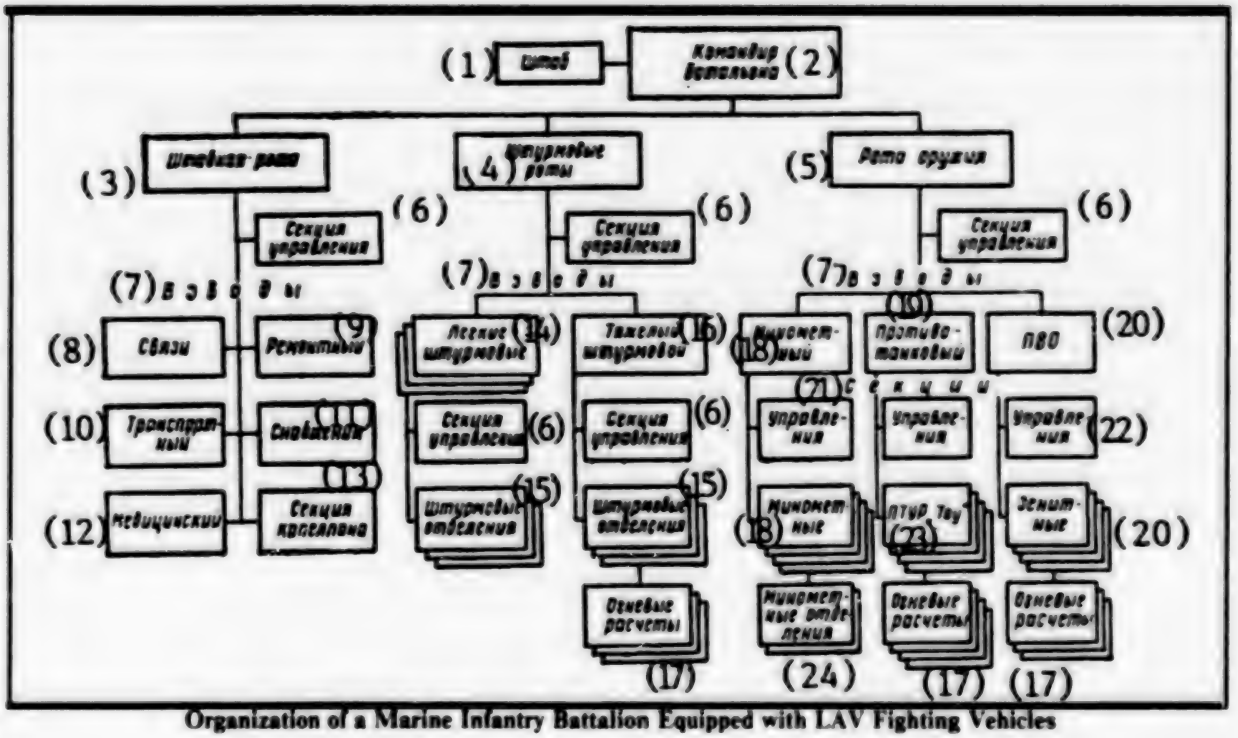
The battalion (see figure) is composed of a staff and five companies—a headquarters company, three assault companies and a weapons company.

The staff (60 persons) carries out the missions of planning, organization and control. The headquarters company includes an administration section, five platoons (communication, repair, transport, supply, medical) and a chaplain's section. The staff and the headquarters company possess a total of 459 persons, 30 LAV fighting vehicles (8 command-and-staff vehicles, 4 infantry fighting vehicles, 2 recovery vehicles and 16 transport vehicles), over 70 truck transport units and other armament. An assault company (147 persons) is represented by an administration section (18 persons, 2 infantry fighting vehicles and 1 recovery vehicle), three light assault platoons and one heavy assault platoon. The light assault platoon has an administration section (five persons, one infantry fighting vehicle) and three assault squads (each containing nine persons and one infantry fighting vehicle). The heavy assault platoon includes, besides an administration section (five persons), three squads of three gun detachments (each containing three persons and one self-propelled gun). An assault company is armed with a total of 24 LAV infantry fighting vehicles, including 14 infantry fighting vehicles, 9 self-propelled guns and 1 recovery vehicle.

The weapons company includes an administration section (15 persons, 2 infantry fighting vehicles) and three platoons—mortar, antitank and antiaircraft. The mortar platoon includes an administration section (11 persons, 2 infantry fighting vehicles) and four mortar sections, each containing two detachments of five persons and one self-propelled mortar. An antitank platoon contains an administration section (five infantry fighting vehicles) and four Tow antitank guided missile sections, each of which consists of four gun detachments (one self- propelled antitank rocket system and three persons in each). The antiaircraft platoon is represented by an administration section (five persons, one infantry fighting vehicle) and four antiaircraft sections (36 persons, 12 antiaircraft self-propelled guns).

Judging from reports in the foreign press, there are over 1,070 persons in a marine infantry battalion equipped with LAV fighting vehicles, to include around 50 officers, 149 LAV fighting vehicles of different types, over 90 5.56-, 7.62- and 12.7-mm caliber machineguns, up to 60 grenade launchers, around 70 motor vehicles and other armament.

In the views of foreign military specialists these battalions are to be used chiefly in their full complement as highly mobile subunits possessing considerable fire power. They are capable of executing a wide range of missions on the battlefield, to include: protecting and defending the landing and deployment areas of expeditionary marine infantry formations; providing fire support to infantry subunits during combat activities; making deep raids into the enemy rear with the purpose of destroying or seizing important objectives; conducting reconnaissance, and so on.



Organization of a Marine Infantry Battalion Equipped with LAV Fighting Vehicles

Key:
1. Staff
2. Battalion commander
3. Headquarters company
4. Assault companies
5. Weapons company
6. Administration section
7. Platoons
8. Communication
9. Repair
10. Transport
11. Supply
12. Medical
13. Chaplain's section
14. Light assault
15. Assault squads
16. Heavy assault
17. Gun detachments
18. Mortar
19. Antitank
20. Antiaircraft
21. Sections
22. Administration
23. Tow antitank guided rocket
24. Mortar platoons

At the same time the possibility of using the battalion's subunits within the composition of company tactical groups to carry out individual missions is not excluded.

Much significance is also attached to creating a mobile strike group out of an LAV fighting vehicle battalion in expeditionary marine infantry formations. Such a group would additionally include artillery and tank subunits and a helicopter gunship subunit.

11004

Swedish Coastal Mobile Antiship Missile System

18010337j Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian
No 3, Mar 88 (signed to press 5 Mar 88) pp 58-59

[Article by Capt 1st Rank R. Mochalov]

[Text] Sweden is developing the RBS-15KA mobile coastal antiship missile system as a means of combatting enemy surface ships in coastal waters. It is intended to destroy targets of medium and small displacement at ranges of up to 100 km, and to knock out individual systems aboard large ships.

The system includes a launcher and a fire control post (Figure 2). The launcher is installed on a truck, and it consists of a four-container unit, auxiliary equipment and a raising mechanism capable of an elevation angle of 22o. Four hydraulically driven supports are used to position the vehicle horizontally.

The transporter-launcher containers are made from an aluminum alloy. In order to reduce the dimensions of the container, the missile is turned 45° within it so that the boosters are oriented on its diagonal.

The missile of this antiship missile system is designed on the basis of the existing RBS-15 ship-to-ship missile (weight with two boosters is 770 kg). It has an aerodynamic "duck" design, a cylindrical body 500 mm in diameter, folding tail fins and steering rudders (its diameter with folded fins is 850 mm, and the span of the fins is 1,400 mm). The missile is guided in sustained flight by an inertial radio altimeter system that supports its straight flight to the target or a programmed turn to the target at a predesignated point; it also guides its flight over obstacles (islands) on the trajectory between the launch position and the target. In the terminal portion of the trajectory the missile is guided to the target by an

active radar homing head made by West Germany's Phillips company. It operates in the frequency range from 15.9 to 17.1 GHz. The homing head is highly resistant to jamming, the width of its search zone is plus or minus 30° in azimuth and plus or minus 15° in angle of sight. The possibility is being considered for designing a combined radar and passive infrared homing head, which could raise its interference resistance and the probability of target kill in the presence of strong electronic countermeasures. The missile's electronic equipment includes a built-in automatic homing head checking unit. The sustainer engine is a French Microturbo TRI-60-1-077 turbojet engine (length 695 mm, diameter 330 mm, weight 53 kg) operating on JP-5 fuel. The missile is launched by means of boosters that operate for 3 sec. The missile is equipped with a high explosive warhead weighing 200 kg.

The fire control point is housed in a truck body, and it is serviced by one officer and three operators. Control commands are transmitted, the status of the missiles is monitored, the raw data are introduced and communication is maintained between the launcher and control post by cable. The launcher can be up to 500 m from the fire control post.

It has been reported that the system is distinguished by sufficiently high mobility. In particular the total time the RBS-15 antiship missile system remains at a launch position is about 5 minutes, which includes the time for launch preparation, to launch the missile and to pack up. A second missile may be launched at a new target 10 seconds after the first. It takes about 1 hour to reload the launcher.

11004

French Murena Antisubmarine Torpedo

18010337k Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian
No 3, Mar 88 (signed to press 5 Mar 88) p 60

[Article by Capt 1st Rank R. Melnikov]

[Text] France is developing the Murena small 324-mm antisubmarine torpedo. It is to be supplied to surface ships, antisubmarine helicopters and shore-based patrol aircraft, and it is to be used as the warhead of antisubmarine guided missiles. The aircraft variant of the torpedo (weight 295 kg) and that used in antisubmarine guided missiles (weight 280 kg) are equipped with a brake parachute.

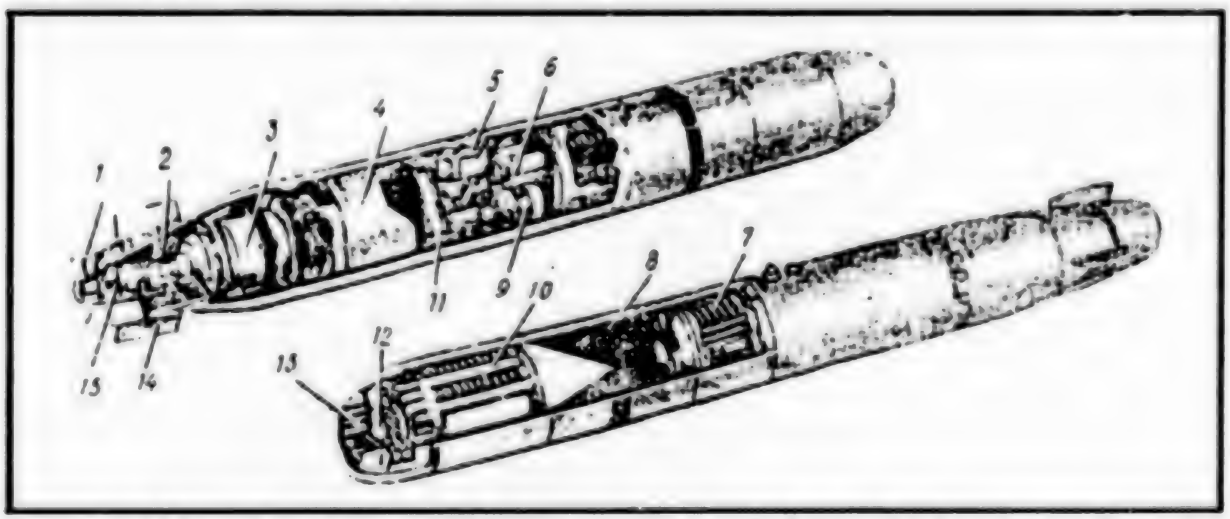
In the estimation of foreign specialists the Murena torpedo will surpass the existing American Mk46 mod.5 and the English Stingray in terms of the cost/effectiveness criterion.

The Murena torpedo uses an electric propulsion unit traditional to French torpedoes, including a storage battery with a silver oxide-aluminum pair of electrodes activated by sea water. It also has an alternating current electric motor designed without commutators to reduce the torpedo's internal noise. Battery capacity is independent of sea water temperature and salinity, and it can support movement of the torpedo for 6 minutes at maximum speed and for 12 minutes at variable speed. The Murena is capable of two speeds (a search and tracking speed of 38 knots and an attack speed of 50 knots), and its range is up to 10,000 m. The propulsion unit is controlled by a system consisting of an inertial unit and a computer consisting of four 16-bit Motorola 68000 microprocessors. They operate in parallel and independently of one another, carrying out the following tasks: They calculate depth, generate commands to the steering rudders, control exchange of information between torpedo systems and support fulfillment of control algorithms and programming of the torpedo's actions. The torpedo's homing system consists of three sonar stations with one forward-looking antenna, two side-looking antennas, one antenna directed downward, and a computer consisting of three Motorola 68000 microprocessors used to process the sonar signals (the processing rate is 50 million operations per second). The computer makes it possible to distinguish between two closely situated targets and to distinguish a real target from a decoy, and it guides the torpedo to the most vulnerable place of the target.

The torpedo's warhead contains a directional charge (weighing around 60 kg), which can penetrate the pressure hull of a submarine at an incidence angle of up to 50o. The torpedo body is made from composite materials consisting of carbon fiber and light alloys, which makes it possible to use the torpedo at depths to 1,000 m while keeping the weight down.

It is anticipated that the Murena small antisubmarine torpedo will enter the French naval inventory in 1991. In the estimation of Western specialists the demand of the French navy will be 1,000 units.

11004



The French Murena Small Antisubmarine Torpedo: 1—steering nozzle; 2—control surface actuators; 3—electric motor; 4—storage battery; 5—sea water valve; 6—auxiliary battery; 7—control system's electronic unit; 8—warhead; 9—pump; 10—homing system; 11—deaerator; 12—side-looking antenna; 13—forward-looking antenna; 14—control rudder; 15—propeller

Military Prod' tion in Belgium

18010337l Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian
No 3, Mar 88 (signed to press 5 Mar 88) pp 61-69

[Article by D. Nilov]

[Text] The military-political leadership of Belgium, which is a member of the NATO bloc, actively supports its militaristic preparations, and it is striving to create a developed military production sector in its national industry.

This sector functions to a significant extent on the basis of assets of the ministry of defense earmarked for equipping the armed forces and creating the infrastructure (including participation in NATO programs, which take up a quarter of the country's military budget). Military-industrial companies are now receiving orders within the state's 10-year plan of military capital investments (for 1986-1995). In addition Belgian firms are actively participating in international arms trade—their direct exports of military products are estimated at 19 billion Belgian francs annually (in 1985 prices) and in cooperative production jointly with other countries.

Military production in Belgium rests on highly developed basic sectors of industry (metallurgy, machine building, electronic industry), and it is practically completely represented by private capital, a significant part of it belonging to foreign concerns.

Today this sector of the economy contains around 20 percent of the companies producing various forms of arms, gear and equipment. Besides this, many Belgian firms that do not produce military end products do subcontracting work, producing parts and units for both national and foreign military equipment. The country has no firms specializing exclusively in military production, while military industry itself and its sectors are not itemized in national statistics. However, Belgian industrial companies produce a wide assortment of aviation, armored and ship equipment, electronic equipment, artillery armament, small arms and ammunition, and parts and units for the latter. These industrial companies of the arms production sector essentially represent the country's military industry. Belgium has around 150 enterprises producing military products. The locations of the principal enterprises are shown in the map in Figure 1. Production of military products was organized in Belgium back before World War II. Thus one of the country's oldest military-industrial companies, Fabrique National, was organized in 1889 to fill a government order for 150,000 repeating rifles. Founded in 1906, Kanon Delkur [transliteration] began specializing in the manufacture of gun barrels. The birth of the country's aviation industry is associated with creation of the aircraft construction company Sosyete Anonim de Belzh de Konstrukson Aeronotik (SABKA) [transliteration] in 1920. During World War II many enterprises involved in military production were destroyed.

The postwar plans of the Belgian government to equip the national armed forces with new weapon systems and the country's entry into the NATO bloc required restoration of military production capacities and organization of arms production. By as early as 1945 Belgium began filling orders for small arms from the USA (2.1 million units).

The insufficient scientific-technical base of some sectors of military industry predetermined the nature of their postwar development: They began orienting on production of large weapon systems under licenses. Thus Belgian aviation industry organized production, under foreign licenses, of Meteor and Hunter jet warplanes (Great Britain) in the 1950s, of F-104 Starfighter fighter-bombers (USA) in the 1960s, Mirage-5B tactical fighters (France) and Islander and Trayslender [transliteration] light military transport aircraft and Defender shore-based patrol aircraft (Great Britain) in the first half of the 1970s, Alpha Jet combat training airplanes (light strike aircraft) (France, FRG) and F-16 Fighting Falcon tactical fighters (USA) in the late 1970s and early 1980s. The country's military-political leadership is presently considering the idea of participation in a French program to design the Rafal fighter.

Reconstruction of ship building industry made it possible to initiate production of "Adjudant" and "Herstal" class minesweepers for the country's navy in the mid-1950s. They were built at the building docks of Belyard (Oostende), Bulverf [transliteration] (Temse) and Mercantile Marine Yard (Kruibeke).

Besides restoring and expanding the weapon and military equipment production base that existed in the prewar period, Belgium created output capacities producing new types of products for the country's military industry. As an example in 1948 Fabrique National organized production of turbojet engines. Having produced over 1,000 engines for Meteor and Hunter fighters, the company joined an international consortium producing American J-79 engines, and later on it participated in the production and testing of French Atar-9C and Larzac engines.

Belgian armor industry was born around 20 years ago. In the mid-1960s, when the Belgian armed forces were being reequipped with new types of armored equipment, a number of the country's firms that had accumulated considerable experience in metalworking and motor vehicle construction received orders for its production. In 1968 Fabrique National began producing FN4RM62 armored vehicles (61 units in all). They were developed on the basis of the chassis of the FN4RM Arden 1.5-ton truck, which is why the design was not technically complex. Other Belgian firms besides the company mentioned above took part in this program—Cockerill-Ugre-Providans [transliteration] (armor plating), Cockerill-Yard-Hoboken (turrets), Bell Telephone (radio equipment), and Shaffer- Uffaliz and OIP [transliterations] (optical instruments).

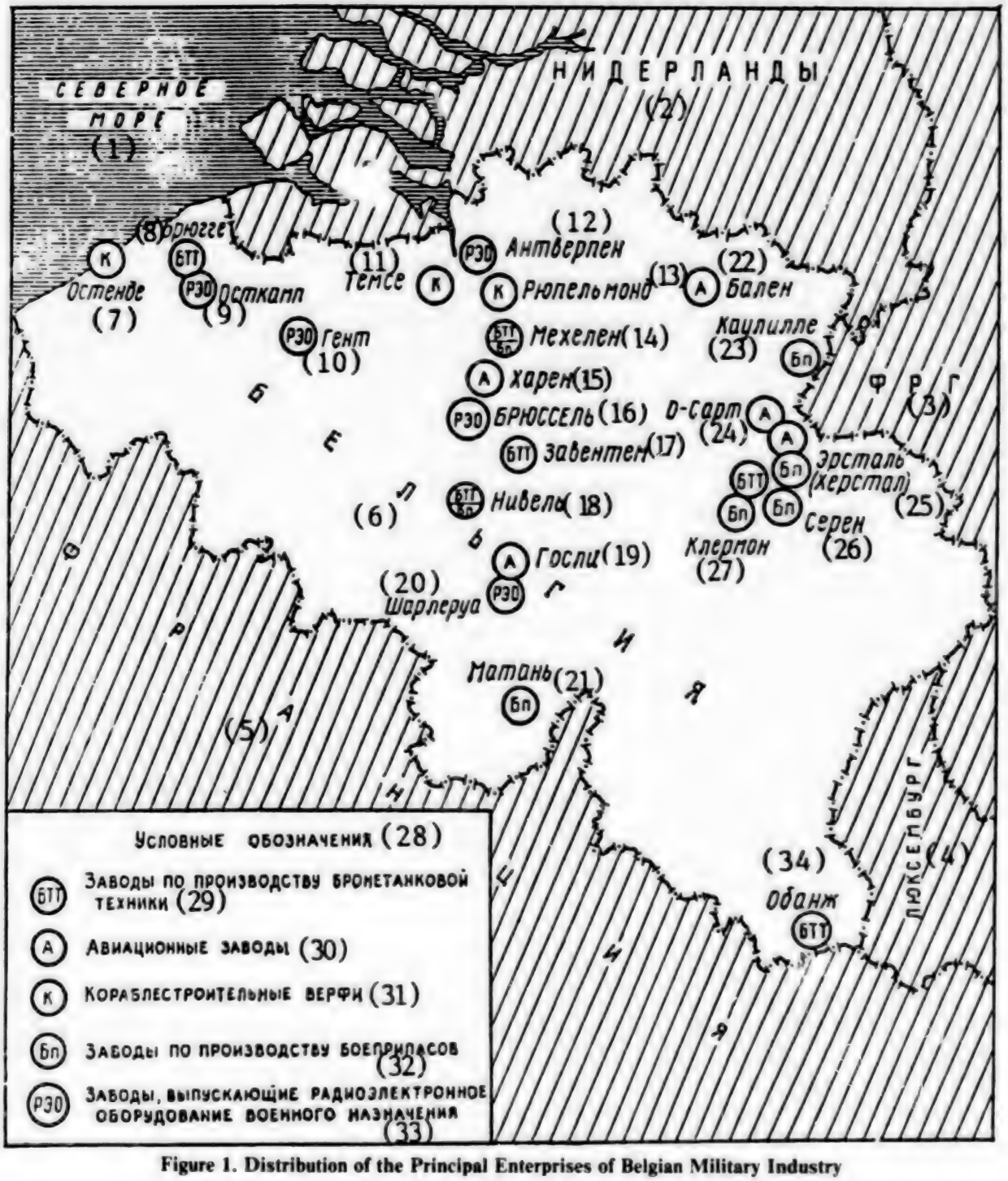


Figure 1. Distribution of the Principal Enterprises of Belgian Military Industry

Key:

1. North Sea	2. The Netherlands	3. FRG	4. Luxembourg	5. France
6. Belgium	7. Oostende	8. Brugge	9. Oostkamp	10. Gent
11. Temse	12. Antwerpen	13. Rupelmonde	14. Mechelen	15. Haren
16. Bruxelles	17. Zaventem	18. Nivelles	19. Gosselies	20. Charleroi
21. Matagne	22. Balen	23. Kaulille	24. O- Sart	25. Herstal
26. Seraign	27. Clermont	28. Legend	29. Armored equipment plants	30. Aviation plants
31. Ship building docks	32. Ammunition plants	33. Military electronic equipment plants	34. Aubange	

An Anglo-Belgian agreement on joint production of armored equipment in the CVR(T)—combat vehicle reconnaissance (tracked)—family was signed in 1970. The prototype vehicle was the Scorpion (a light reconnaissance tank). The bulk of the 700 tracked armored vehicles ordered by Belgium were assembled at enterprises of England's British Leyland in the Belgian city of Mechelen.

Belgium's largest electromechanical firm (Atelier de Construction Electrique de Charleroi—ACEC), which was founded in the end of the last century, created its own military division in 1960. The company has four enterprises in the country—in the cities of Gent, Herstal, Charleroi and Drogenbos (in the vicinity of Bruxelles) with a total area of over 18,000 m2. They employ 8,000 persons.

ACEC was fitted out for joint interstate programs to produce the Improved Hawk antiaircraft guided missile, the Gepard self-propelled antiaircraft gun and armored vehicles of the CVR(T) family, and it supplied 400 electric motors for French Crotale self-propelled antiaircraft missile systems. The firm's current production assortment includes parts, units and monitoring and measuring instruments for Milan antitank guided rocket launchers, various air trainers, and components for space equipment. It makes a significant contribution to creating minehunters developed in the Tripartite project, the RITA automated communication system and many other projects.

The considerable experience accumulated by ACEC served as the basis for development of the Cobra-41 armored personnel carrier in 1977 on its own private initiative. Belgium's defense ministry participated in the financing of scientific research and design. The armored personnel carrier is now ready for series production (in different modifications), but there have been no orders for it yet. ACEC's wide participation in joint interstate (cooperative) arms programs and work done on the basis of foreign subcontracts mean that this firm makes a large contribution to exports (up to 45 percent) in the total annual turnover (around 14 billion Belgian francs).

Besides ACEC, the firms ASKO, BMF, SOREMI, Begerman-Demoyen Engineering (BDE) and BN Konstryukson Ferrovyer e Mettallik (BN) are working in one of the most highly developed sectors of Belgian military production—armored equipment.

ASKO was founded in 1954, and its capital totals 100 million Belgian francs. The company's production activity centers on parts and units for armored equipment, predominantly foreign—the Leopard tank, the Jagdpanzer self-propelled gun, the Bergepanzer armored recovery vehicle, the Flakpanzer self-propelled antiaircraft gun (FRG), the Chieftain tank, CVR(T) family armored vehicles (Great Britain), the AMX-30 tank, AMX-10 and AMX-13 family armored vehicles, the VAB armored personnel carrier (France), the M41, M48 and M60 tanks, the M74, M75 and M113 tanks, the AIFV infantry fighting vehicle and the Improved Hawk self-propelled antiaircraft gun (USA). In addition the firm manufactures various components for missiles and aircraft (the Swingfire, Hot and Milan antitank guided rockets, the Roland antiaircraft guided missile, the A310 and A320 airplanes, etc.).

ASKO is constantly widening its production base. Its new industrial complex in Zaventem (in the vicinity of Bruxelles), which is outfitted with modern production equipment, opened its doors in 1973. It employs only 300 persons, while the shops occupy an area of around 11,000 m2.

In 1978 the firm formed a daughter company—SOREMI—in Gras-Olon [transliteration] to produce spare parts and to modernize and modify armored equipment. SOREMI has modernized 200 armored vehicles based on the AMX-13 light tank for Indonesia and American M41 tanks for a number of countries. Despite its small size (its capital totals only 2 million Belgian francs, and it employs 70 persons), owing to its narrow specialization the company can react flexibly to the needs of its client, ensuring high productivity and profitability even with small orders.

One of the leading Belgian firms producing steel structures is BN (known formerly as Bryuzhuaz e Nivel [transliteration]), the annual turnover of which is approaching 7 billion Belgian francs. Around 4,000 persons are employed at five of its plants in the cities of Brugge, Nivelles, Manage, Belkur [transliteration] and Famiyoro [transliteration]. In 1975 it completed independent scientific research and design work aimed at creating the SIBMAS [transliteration] amphibious multipurpose wheeled (6x6) armored personnel carrier. A family of armored vehicles (around 10 variants) has now been developed on its basis, to include an armored personnel carrier, a self-propelled antitank missile system (equipped with Hot, Tow or Milan antitank guided rockets), a self-propelled antiaircraft gun, a self-propelled mortar, an armored reconnaissance vehicle, a command-and-staff vehicle, a recovery vehicle, an ambulance and a transport vehicle.

In 1981 BN received a contract worth a total of 4 billion Belgian francs (100 million U.S. dollars) to produce 186 SIBMAS armored personnel carriers (including 24 in a recovery vehicle modification) for the armed forces of Malaysia. The production program was estimated at 1.2 million man-hours of working time, and it was completed in 1983-1985. Deliveries were made at a monthly rate of 20 armored personnel carriers, though the assembly line can produce 40 vehicles a month.

In 1986, because orders for the SIBMAS were not forthcoming, the rights to its production and sales were transferred to the Belgian firm Belgian Mechanical Fabrication (BMF). This firm was founded in 1977 on a shareholding basis by ASKO, Cockerill and Brussel

Damber [transliteration], which possess 55, 37 and 8 percent of its shares respectively. The founding of BMF is connected with a program to reequip the Belgian ground troops with American AIFV armored fighting vehicles and M113 armored personnel carriers and with a decision of the country's government to purchase the license for their manufacture from the USA.

After the American-Belgian license agreement was signed, in 1981 BMF opened a plant with an area of 95,000 m2 in the city of Aubange employing 170 persons. The firm produces hulls for armored vehicles (20-24 per month), while companies founded by it produce suspensions, commander's cupolas (ASKO) and some hull parts (Cockerill). Hulls and commander's cupolas with optical and electronic apparatus and armament mounted on them are sent to the assembly line of West Germany's Khenshel [transliteration] company in Antwerpen (Belgium). Engines and transmissions are supplied to the assembling enterprise by the USA. The proportionate participation of Belgian companies and American suppliers in the cost of work done in this program is 70 and 30 percent respectively. Belgium will assemble, and deliver to national armed forces, a total of 514 AIFV infantry fighting vehicles (three modifications) and 525 M113 armored personnel carriers (11 modifications). Although foreign specialists predict that their manufacture will be completed in 1988, the Belgian companies plan to continue the production program, orienting on possible export of these vehicles and of parts and units for them (with the permission of the U.S. State Department). BMF has already received an order from the Netherlands for delivery of 26 armored hulls.

One of the largest Belgian motor vehicle building concerns—BAT—has concentrated military production at a plant of one of its divisions, Begerman-Demoyen Engineering (BDE) in the city of Mechelen. In 1976 this division acquired a license from Ireland's Company of Technology Investment to manufacture an improved version of the Timony armored personnel carrier—the BDX. In 1977 Begerman-Demoyen Engineering received an order from the government for 43 armored personnel carriers for the Belgian armed forces, and 80 armored personnel carriers for the police; their manufacture was started practically right away. In 1979 five BDX armored personnel carriers were manufactured in response to an order from Argentina.

In 1981 BDE signed a 10-year contract with Vickers Defence Systems (Great Britain), in accordance with which the English firm is the chief in a joint program of scientific research, design and production of a modified model of the BDX. Development of this armored personnel carrier has basically been completed, but orders for it are not yet forthcoming.

Belgian aviation industry, the Western press notes, employs around 7,000 persons, of whom 10 percent are engineers and administrators, 18 percent are technicians, 12 percent are white-collar workers, 53 percent are skilled workers and 7 percent are unskilled workers. The bulk of its production capacities (70-80 percent) are involved in fulfilling military orders; in this case the proportion of military production within the total turnover of the leading aircraft building companies of Belgium, SABKA and SONAKA [transliteration], attains 90 and 85 percent respectively.

Not only the country's aircraft building companies but also companies of associated industrial sectors participating in the creation of aviation equipment were combined in 1952 into a Belgian group of aviation equipment producers, ZhEBEKOMA [transliteration]. The group includes nine companies—SABKA, SONAKA, FN, Dassault Belgique, ACEC, Phillips and MBLE Associated, Bell Telephone, SAIT Electronic [transliteration], and Sosyete Belzh d'Optik d'Enstryuman de Presizon [transliteration].

These firms are the largest in aircraft building, and they possess considerable production experience. Most of them are based in the country's Walloon area. Therefore as a counterweight to the ZhEBEKOMA group, in 1980 the aerospace group FLAG (Flemish Aerospace Group) was formed in Flanders with its headquarters in Antwerpen. FLAG is not a production organization. Its main task is to assist in the development of aviation industry in Flanders, to lobby for large orders for firms belonging to the group, and to promote higher competitiveness of industrial enterprises in the Flemish part of Belgium. The FLAG group contains around 80 companies associated to some degree or another with aviation industry; they employ a total of more than 50,000 persons.

It is noteworthy that FLAG includes several large Belgian firms that are also members of the ZhEBEKOMA group. Well known among the principal companies in FLAG are ASENKORD, ADB, ASKO, Bekart, FMS-FME, MBLE, GTE- ATEA and Barko Electronics [transliterations].

The bulk of the products of firms in both sectorwide associations are manufactured on the basis of licenses and subcontracts from the leading foreign aircraft building companies—Aerospatiale, Dassault-Breguet (France), British Aerospace, Rolls Royce (Great Britain), General Dynamics, McDonnell Douglas, General Electric (USA) and the international consortium Airbus Industry.

The most significant aircraft building program in Belgium today is concerned with production of parts and units for the American F-16 tactical fighter and its assembly. Belgian industry received large orders in the "deal of the century," as the Western press referred to the 1975 agreement for joint production of F-16 airplanes by the USA, Belgian, Denmark, the Netherlands and Norway. Just in the first phase of the program (production of 650 aircraft for the U.S. Air Force and

348 for West European countries) the volume of work carried out in Belgium was estimated at $721.2 million (a third of all European orders).

On the Belgian side, four companies are involved in the fighter's manufacture—SABKA, SONAKA, FN and MBLE. Moreover this program provides most of the work for the first three companies. The program employs over 3,500 persons—950 at SABKA plants, 880 at SONAKA plants, 1,700 at FN plants and 50 at MBLE plants.

SABKA uses two aircraft building plants occupying a territory of 78,000 m2 in the cities of Haren and Gosselies to fill orders in this program. They employ around 2,000 persons. The ratio of the work they do is 2:1, which is also the ratio of the number of people the first and second enterprises employ. The plant in Haren manufactures wings for the F-16 airplane, while the plant in Gosselies manufactures airframe components and carries out final assembly and testing of fighters for Belgian and Danish air forces.

Besides contracts under the F-16 program, the company's portfolio of orders includes production of parts and units for Mirage-3, -5 and -7.1, Alpha Jet and F-104 warplanes, F.27 and F.28 military transport airplanes, Atlantic and Atlantic-2 shore-based patrol airplanes and Puma, Alouette-2 and -3 helicopters, and modernization and repair of these aircraft.

SONAKA was founded in 1978 on the basis of a Belgian enterprise belonging to the bankrupt English Fairey Company. Over half of SONAKA's shares are held by the state. It is typified by the highest worker skill level in the sector. It possesses production space totaling 67,500 m2 in Gosselies (Figure 3 [not reproduced]), where 1,750 persons are employed. The enterprise manufactures the tail sections of the fuselage and vertical stabilizer of the F-16 fighter, and it carries out preliminary assembly of the airframe (prior to installation of the engine). The company participates in the program for manufacture and technical maintenance of Mirage-3, -5 and F.1, Alpha Jet, C-130, C-141, Boeing 747, Atlantic and Atlantic-2 airplanes and Alouette helicopters.

FN (Fabrique National) manufactures F100 and F110 engines for all European-made F-16 tactical fighters, and it conducts tests on them. Construction of a new engine building enterprise in the city of O-Sart in the mid-1970s and modernization of the test bench, on which more than 3 billion Belgian francs were spent, are associated with this task. This plant and enterprise in the city of Herstal not only deliver engines in the F-16 program but also participate in the production of other aircraft and rocket engines, chiefly American and French.

Around 30 percent of the company's annual turnover, which averages 30 billion Belgian francs, consists of aviation orders. FN's aircraft building sector employs 2,500 persons. Not only is the firm involved in production pertaining to export orders, but it also is promoting expansion of the base of national aviation industry. Thus in 1981 it took part in the founding of the company Technical Airborne Components and construction of its shops in the city of O-Sart. FN owns a third of the capital of the new aircraft building company.

Phillips and MBLE Associated fills orders for America's Westinghouse for the manufacture of electronic equipment for the F-16 fighter. The Belgian firm owns four enterprises in the country employing 3,200 persons. Purely military products make up 12 percent of the company's turnover; however, this is enough for it to be successful in the international military electronics market.

Large capital investments into scientific research and development (10 percent of annual turnover) make this firm's projects highly competitive. As an example it was one of the first in the NATO countries to produce reconnaissance drones. The company designed two such aircraft—the Epervye (for national armed forces) and the Asmodey (for export) [transliterations].

Dassault Belgique Aviation (Figure 4 [not reproduced])—an affiliate of France's Dassault-Breguet—is another company in Belgian aviation industry. It was founded in 1968 after signing of a Franco-Belgian agreement to supply the Belgian air force with Mirage-5 fighters. The company limits itself to participation in production of Mirage fighters, Alpha Jet combat training aircraft (light strike aircraft) and to most of the Dassault-Breguet programs. Its sole enterprise in the city of Gosselies employs around 160 persons.

In 1982 the country's largest ship building firms, Bulverf and Cockerill Yard, merged into a new company, Bulverf N.B. Both of its building docks (in Hoboken and Temse), which had formerly delivered escort ships to the Belgian navy, including E-71 class guided missile frigates (Figure 5 [not reproduced]), are involved in the country's sole warship building program. It foresees production (on a joint cooperative basis with France and the Netherlands) of 10 "Aster" class minehunters for national navies (in the Tripartite program). They are assembled at the ship building plant belonging to SN de Rupelmonde. Nonmagnetic hulls for the minehunters are supplied to an assembly enterprise in Rupelmonde by a new plant specially built for their production by Mercantile- Belyard (Oostende). All national companies involved in the Tripartite program formed the consortium Polyship. Three ships have been transferred to the navy, while the rest are in different stages of construction, or they have been ordered from industry. Construction of the series is to be completed in 1991.

Companies producing artillery armament, small arms and ammunition occupy a major place in military production.

The company Kanon Delkur specializes in the manufacture of parts and units for artillery and small arms requiring high working precision, and weapons with optical sights. Owing to sophisticated equipment installed in the shops and presence of highly skilled manpower, Kanon Delkur can not only carry out technically complex jobs but also modify weapon models in accordance with the specific requirements of clients. As a result the firm's products are widely represented in the world market, and they are supplied to over 30 countries.

Belgian industry involved in the production of artillery armament and small arms does not manufacture field artillery guns. However, it does manufacture 52-, 60- and 81-mm caliber mortars (the PRB company), and it specializes in the production of guns for various types of armored equipment. Two Belgian firms are well known as major suppliers of such items—Cockerill and Mekar [transliteration].

In 1974 Cockerill began development and then initiated production of Mk1 and Mk2 90-mm guns intended for light armored equipment; as a result of their modernization, in 1977 a new model was created, the Mk3, followed by the Mk4.

The company's 150 blue and white collar workers fill orders for production of these guns in different modifications in accordance with the combat characteristics and requirements of specific models of armored equipment, included as a unit with gun turrets of its own design. Thus Cockerill created a special turret with a 90-mm gun for the Scorpion light tank—the AC-90. A turret and gun system, the CM-90, was manufactured in 1977 for Malaysia adapted to the climatic conditions of this client. In 1976 Cockerill sold a license for production of the Mk2 gun to Brazil's ENZheSA [transliteration] (the modification was designated the EC-90).

This firm's guns are often installed on experimental and prototype models of armored equipment undergoing testing. More than 1,000 units were delivered to various countries for installation aboard tracked and wheeled armored vehicles such as the V-150, V-300, Dragoon-300 and M113 (developed by American companies), the FS100 and the Scorpion family (Great Britain), the VBC-90 and Sage (France), the Piranha (Switzerland), the TPz-1 and the Condor (FRG), the BMR-600 (Spain), the SIBMAS (Belgium) and others. The Mk3 gun is being installed on 17 types of armored personnel carriers and infantry fighting vehicles, and it is being used in 20 countries.

Founded in 1938, Mekar developed and produces 90-mm guns for armored equipment designed by Movag [transliteration] (Switzerland), Cadillac Gage and Food Machinery and Chemical Corporation (USA) and others. It employs around 400 persons, and the main enterprise is located in Nivelles. However, the firm specializes mainly in production of various forms of ammunition—primarily shells for 90-mm guns, and ammunition for practically all types of grenade launchers and mortar shells for 81-mm mortars.

In 1984 Mekar significantly expanded its product assortment, having started production of shells for guns and howitzers of 105, 155 and 203.2 mm caliber, and in 1985 it organized manufacture of 60- and 100-mm ammunition. A new plant was built for this purpose. Expansion of production provides the firm a possibility for bringing in new clients and increasing exports, which presently service 14 countries.

Fabrique National is responsible for designing small arms and ammunition (calibers from 12.7 to 40 mm), Browning Mk2 9-mm pistols, Browning M2HB machineguns, 5.56-mm caliber weapons (the FNC carbine, the Minimi light machinegun, SS-109 cartridges) and 7.62-mm caliber weapons (the FAL automatic rifle and different modifications of the MAG machinegun, (Figure 6 [not reproduced]). Small arms and ammunition of 5.56 and 7.62 mm caliber produced by Belgium's FN have been approved as the standards for NATO armies, and they are sold to them. Besides this they are supplied to many other states—80 countries in all.

Belgium's PRB is known far beyond the country's borders as a supplier of explosives and powders, ammunition for artillery guns, grenade launchers, unguided rockets (less than 40 mm caliber), 60- and 81-mm mortars, hand and rifle grenades, antitank and antipersonnel mines and booby traps. Over 95 percent of the firm's products are exported. The headquarters of PRB (in Bruxelles) and the firm's six plants employ around 3,000 persons.

The bulk of Belgian firms in electronics industry fill military orders. This sector is represented chiefly by enterprises of Bell Telephone, SAIT Electronics, ACEC, Phillips and MBLE Associated, OIP, Simens and SABKA, which produce communication resources and navigation and computer equipment for national armed forces and for export. Almost all of the largest firms of this sector are controlled by foreign capital. Most of the country's companies representing military electronics are in the sector-wide SIBILEK [transliteration] association.

A tendency for growth of exports of production processes and industrial equipment used in the production of weapons and military equipment has been observed in recent years. As an example Belgium is providing considerable assistance to the development of military industry in Turkey, and particularly in sectors such as aviation (assembly of F-16 tactical fighters), armored vehicle industry, electronics industry and munitions industry. Regional cooperation in arms production with firms of neighboring countries—the Netherlands and Luxembourg—is expanding as well. An agreement to

standardize weapons and military equipment has been signed with these countries, opening up additional possibilities for export of Belgian products.

Thus despite the country's small size, military production in Belgium is represented by a number of large companies operating in both national and foreign markets. An orientation predominantly on production under licenses and on importation of various types of armament should be viewed as obstacles to the development of this sector. Only around 1 percent of the country's military expenditures are allocated to scientific research and design work in this field. These assets are used mainly to develop small arms, ammunition and light armored equipment. "Although the country's military industry is not independently producing large weapon systems," noted the journal MILITARY TECHNOLOGY, "it is felt to be a dependable partner to international giants representing this business."

11004

Italy's Principal Oil Pipelines

18010337m Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 3, Mar 88 (signed to press 5 Mar 88) pp 70-73

[Article by Doctor of Technical Sciences A. Belkin and Candidate of Technical Sciences G. Guzhavin]

[Text] The armed forces command of the North Atlantic alliance believes pipeline transport (both military and civilian) to be the most effective means of centralized supply of fuel to troops in European theaters of military operations. This is why the system of measures to prepare the territory of bloc countries, including Italy, for operations (with regard for the corresponding plans developed in NATO) lays special emphasis on improving the network of oil pipelines and pipelines for transporting oil refining products (often referred to as product pipelines) from seaports to internal regions and from oil refineries to petroleum product depots and bases having the responsibility of supplying armed forces units and subunits.

The first product pipelines appeared in Italy in the late 1940s. These were military installations built and used by the American army and by the armies of its NATO partners. In the early 1950s the country began designing and building product pipelines in behalf of civilian enterprises, and in a relatively short time (around 15 years) over 20 pipelines of various lengths were built. The productive capacities of oil refining industry grew from 19.3 million tons of crude oil in 1956 to 141.7 million in 1968. The need for satisfying the continually growing demand of the armed forces for POL became the primary impetus for development of oil refining industry. In the minds of the NATO leadership, Italy, which was at the midpoint between oil sources in the Near East and the industrial regions of Western Europe, had to become an important fuel supply center for NATO troops in Western Europe. Significant assets were allocated to the creation of a sector that was essentially new in the country.

As a result Italy's oil refining industry became the largest in Western Europe (200 million tons of crude oil per year), and oil became the basis of its power production (over 70 percent of the energy balance). Relatively small but well-equipped oil refineries process imported oil (around 98 percent) brought in by sea predominantly from the Near East. The largest oil refineries are on the coast in the port cities of Genoa, La Spezia, Livorno, Trieste, Venice, Bari, Milazzo, Augusta, Priolo and others, as well as in regions of highest consumption of petroleum products, to which the oil is fed by oil pipelines—Lombardy for example.

Intensive construction of petroleum product pipelines of various types continued into the early 1980s. But then this process slowed down dramatically in connection with a reduction in the existing capacities of oil refineries for direct distillation of petroleum. Nonetheless by early 1987, according to the foreign press, the total length of commercial oil pipelines was around 3,700 km. The total length of all of the country's mains, including gas pipelines, attained almost 10,000 km. The bulk of the pipelines (from 30 to 150 km long) were erected in northern industrial regions, while the rest were installed in central Italy and on the island of Sicily (see figure). The assortment of petroleum products conveyed by the pipelines contains up to 40 types and grades, most of them being in the light category. Light petroleum products carried by a number of pipelines include light fuel oils used as ship or boiler fuel.

A little more than half of the product pipelines consist of piping with a diameter from 100 to 150 mm, around 40 percent have a diameter of 200- 250 mm, and the rest are 410-1,016 mm in diameter. NATO military specialists believe that their operation makes it possible to create the needed fuel reserves at the country's northern borders in the shortest time. These reserves can be accumulated and replenished not only from resources concentrated at more than 100 of the country's depots and bases but also with fuel from seaports equipped for tanker off-loading. Fuel can also be dispensed to the navy's rear support vessels from depots at the ports of Genoa, Savona, La Spezia, Ravenna and others, as well as from naval bases at Taranto, Ancona, La Spezia, Augusta and elsewhere.

Besides serving their primary purpose, pipelines are also convenient for petroleum product storage. The product pipelines alone (not counting oil and gas pipelines) disperse over 80,000 tons of fuel over a significant area of Italy. They are usually installed in avoidance of the

Principal Pipelines Planned for Use for Military Purposes

Key:

1. Turin	2. To Ingolstadt	3. Trecate	4. Milan	5. Cremona	6. Piacenza
7. Parma	8. Bologna	9. La Spezia	10. Genoa	11. Vado Ligure	12. Florence
13. Livorno	14. Perugia	15. Civitavecchia	16. Rome	17. Ancona	18. Ravenna
19. Mestre	20. Treviso	21. Aviano	22. Trieste	23. Sicily	24. Enna
25. Augusta 26. Ragusa	27. Gela	28. Legend	29. Oil pipelines	30. Gas pipelines	

most important objectives of interest to the enemy, their piping is laid in the ground up to 1.5 m deep, and therefore it is relatively invulnerable to enemy strikes.

Among the sizable number of Italian product pipelines that according to the Western press are to be used in the interests of the armed forces of the North Atlantic bloc, the following are of the greatest interest (see table). The La Spezia-Montechiaro d'Asti product pipeline (located 35 km east of Turin), which has a capacity of over 2,000 tons per day, originates at a large oil refinery in the vicinity of La Spezia. Crude is delivered to the oil refinery by marine transport. This pipeline system carries light petroleum products, chiefly jet engine fuel. The Ravenna- Bologna-Parma product pipeline, which has a daily capacity of 1,200 tons, extends from the oil refinery in the vicinity of the port of Ravenna. It carries a succession of different grades of gasoline and diesel and aviation fuel. The Vado Ligure-Trecate pipeline begins in the vicinity of the seaport of Savona. Its equipment makes it possible not only to create fuel reserves at intermediate and terminal points but also to transload fuel to rail transport in the vicinity of Alessandria and at the terminal point, and to pump fuel in the reverse direction—to the coastal zone. Its daily capacity is over 4,500 tons. The route of a product pipeline leading to Perugia begins on the western shore of the Adriatic Sea, at the port of Ancona. It delivers light petroleum products (up to 5,000 tons per day) to distributing petroleum bases deep within the country with the purpose of creating reserves and satisfying the needs of consumers.

Livorno, on the Ligurian Sea, is the place where ships of the U.S. 6th Fleet replenish their fuel reserves. This port's turnover exceeds 20 million tons, two-thirds of which is represented by oil delivered from oil refineries and petroleum products transferred to ships and vessels. This is also the origin of the pipeline of the Livorno-Florence system. It consists of two lines laid in parallel with a daily capacity of almost 3,200 and 6,400 tons of products. The system can transport different fuels in succession—from motor to boiler. Three parallel lines of a product pipeline transferring fuel with a daily capacity of around 1,200, 5,000 and 6,400 tons is laid from oil refineries of Civitavecchia on the Tyrrhenian coast to the vicinity of Rome.

The Cremona-Piacenza product pipeline has a capacity of around 6,400 tons per day, and it is a binding link between important transportation centers.

Two product pipelines have been installed in Sicily: The Gela-Enna (with a daily capacity of around 2,100 tons),

Product Pipeline	Length, km	Pipe Diameter, mm
La Spezia - Montechiaro d'Asti	400	100, 150
Ravenna - Bologna - Parma	200	100
Vado Ligure - Trecate .	140	200
Ancona - Perugia	110	-
Livorno - Florence . . .	80	150, 250
Civitavecchia - Rome . .	72	100, 200, 250
Cremona - Piacenza . . .	32	250
Gela - Enna	66	150
Ragusa - Augusta	66	470

Main Product Pipelines Planned for Use in Behalf of Armed Forces

which is used to deliver different types of fuel from oil refineries to the island's center, and Ragusa-Augusta (with a daily capacity of 20,000-25,000 tons), which delivers petroleum products from oil refineries to the naval base at Augusta, which is one of the largest fuel supply points for ships of the Italian navy and the U.S. 6th Fleet.

Judging from reports in the foreign press, the presently existing system of oil pipelines in Italy basically satifies the requirements imposed on it by the military leadership of the NATO bloc, and it is capable of transporting petroleum products in behalf of the country's armed forces in the initial period of a war and during the country's transition to a war footing. In this case around 85 percent of the system's pipelines are presently loaded to around four-fifths of their capacity.

Besides pipelines primarily satisfying the country's internal needs, oil mains having all-European significance pass through its territory. These include the Central European oil pipeline, which originates at the port of Genoa and passes through northern Italy and then to the FRG (Ingolstadt), and the Transalpine Trieste-Ingolstadt pipeline, which crosses Austria. These pipelines give off a large number of branches to various oil consumers.

It was noted in the Western press that Italy is considering the issue of converting oil and gas pipelines made from piping of small and moderate diameter to petroleum product transport when necessary. This would make it possible to maneuver reserves of the latter more broadly and disperse them to a greater extent by their storage in the pipelines themselves. There is a certain amount of interest in this connection in the Genoa- Ingolstadt, La Spezia-Treviso-Aviano (400 km long) and Genoa-Milan oil pipelines and the Cremona-Mestre-Trieste (332 km long, pipe diameter 203-406 mm) and Ravenna-Bologna-Cortemaggiore-Turin (398 km long, pipe diameter 305-406 mm) gas pipelines located in northern Italy.

11004

The Seikan Submarine Rail Tunnel

18010337n Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 3, Mar 88 (signed to press 5 Mar 88) pp 73-74

[Article by Col V. Rodin]

[Text] The world's largest underwater tunnel, the Seikan, is to become operational in Japan in spring 1988. This event, in the opinion of the Japanese press, is an important stage in the development of the country's railways. The fact is that until this moment, the country has not possessed a unified system of ground transportation lines. A branching network of motor highways and railroads correspondingly over 1 million km and around 28,000 km long has been created within the bounds of each of the four principal Japanese islands (Hokkaido, Honshu, Shikoku, Kyushu), providing communication with the most remote regions of the country. But only three of the islands have been joined together by transportation lines—Honshu, Shikoku and Kyushu. These islands were connected together by motor vehicle and railroad bridges; in addition, two underwater railroad tunnels were laid between the islands of Honshu and Kyushu. Therefore when the Seikan submarine railroad tunnel goes into operation, connecting Honshu to Hokkaido, it will become the final stage in creation of a unified surface transportation system in Japan.

The tunnel will link the points of Hamana and Yunosato located on the indicated islands, correspondingly in the Prefecture of Aomori (Honshu) and in the vicinity of Hakodate (Hokkaido, Figure 1). The tunnel is laid beneath the floor of the Tsugaru Strait, which is 140 m at its deepest point. The tunnel is laid up to 100 m beneath the floor of the strait. The overall length of the structure is around 54 km; of this amount, the submarine part is over 23 km. It has been under construction since 1964.

In accordance with the plan, three tunnels were laid beneath the floor of the strait: a main tunnel (11 m in diameter) and two service tunnels (5 m each). After reinforcement and finishing of the walls, the greatest width of the first of these is 9.6 m, and its height is 9 m. A double railroad line (track width 1,435 mm) is laid within it, and track equipment is installed. Railroad lines lead to both tunnel entrances.

Before opening of the tunnel to traffic, the bulk of the cargo and passenger traffic between Hokkaido and other Japanese islands was supported by marine (cargo) and air (passenger) transport. Use of rail lines was limited by the capabilities of the ferry crossing operating between the cities of Aomori and Hakodate, which was insufficiently reliable: In certain years ferry traffic across the strait has been interrupted due to storms for a total of up to 2 months, and disasters have occurred with significant losses of human life. In the estimation of the planners, the capacity of this tunnel will be up to 30 pairs of trains per day (25 million passengers and 20 million tons of various cargo per year), which will exceed by several times the capacity of ferries operating on the crossing.

The problem of reducing travel time by rail from Hokkaido to other regions of the country is to be resolved simultaneously with the start of operation of the Seikan tunnel. Thus while a trip from Tokyo to Sapporo (the administrative center of Hokkaido) by rail using the Aomori-Hakodate ferry crossing takes around 20 hours, after the tunnel goes into operation and high-speed trains are launched, the trip time will decrease to 6 hours.

The Japanese military leadership attaches important significance to commissioning of the new tunnel. This is associated with the fact that Japan's national defense administration has noted on several occasions, under the contrived excuse of "growth of a Soviet threat," that in

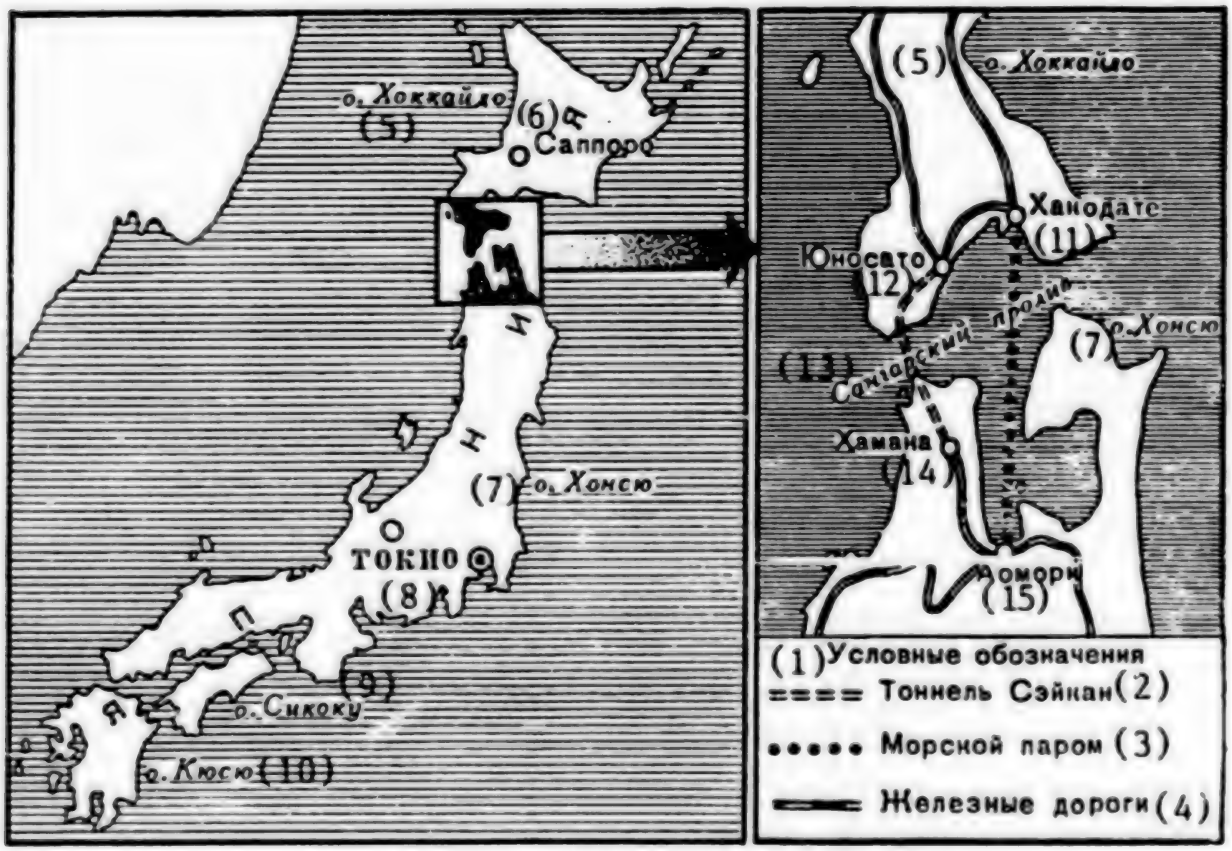


Figure 1. Diagram Showing the Route of the Seikan Tunnel

Key:

1. Legend	2. Seikan tunnel	3. Sea ferry	4. Railroads	5. Hokkaido
6. Sapporo	7. Honshu	8. Tokyo	9. Shikoku	10. Kyushu
11. Hakodate	12. Yunosato	13. Tsugaru Strait	14. Hamana	15. Aomori

the future it intends to create a large troop grouping on the island of Hokkaido for combat activities in the northern direction. Missions concerned with quick build-up of troops in the country's northern regions are already being practiced in the course of the combat training of the "self-defense forces." In the estimation of the Japanese command, presence of the Seikan tunnel will make it possible to quickly and covertly transfer formations and units of the "self-defense forces" to Hokkaido.

In recent years some Japanese economists have suggested that the tunnel might be unprofitable in the future owing to growth of the cost of rail travel and reduction of its proportion in the freight turnover between the islands of Honshu and Hokkaido. It was concluded that without significant financial assistance, including on the part of the state, opening of the rail line would be unfeasible. Various plans for using the tunnel for other than its primary purpose have appeared. One of them even suggests creating plantations in which to grow mushrooms for export. Lengthy debates have begun in government circles. In this case the interest displayed in this facility by the leadership of the national defense administration has influenced adoption of the final decision on the tunnel's operation.

On the whole, foreign military specialists note, commissioning of the Seikan tunnel has important economic and military significance to Japan, since it creates conditions for development of one of its largest islands, and it significantly raises the capabilities of the transportation system in the country's north for military shipments.

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U.S. 3d and 8th Mechanized Divisions

18010337o Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian
No 3, Mar 88 (signed to press 5 Mar 88) p 75

[Article by Lt Col I. Alekseyev]

[Text] Continuing to implement measures to develop ground troops in the "Army-90" program, the American

command is pursuing the goal of creating formations possessing high fire and striking power and tactical mobility, capable of conducting lengthy combat operations employing conventional and nuclear weapons. Judging from reports in the foreign military press, the 3d and 8th mechanized divisions of the regular army, which are within the composition of the American ground troop grouping in the European zone, are undergoing reequipment and conversion to a new organizational structure.

The 3d Mechanized Division (its emblem is shown in Figure 1 [figures not reproduced]), which is located in the FRG (its headquarters is in Wurzburg), is within the composition of the 7th Army Corps, and it is intended for missions in its first echelon. The 8th Mechanized Division (Figure 2, also in the FRG, with its headquarters in Bad Kreuznach) is in the 5th Army Corps, and it is intended for operations predominantly in its first echelon.

Organizationally, each of the divisions contains a staff and a headquarters company, three brigade staffs, five motorized infantry and five tank battalions, an artillery division (an MLRS multiple rocket launcher battery (1) and three 155-mm self-propelled howitzer battalions), an army air brigade, a reconnaissance, an electronic warfare, communications and an engineer battalion, a military police company and a mass destruction weapon protection company. Their present strength is 19,647 persons each (2), 9 MLRS multiple rocket launchers and 72 155-mm self-propelled howitzers, 290 M1 Abrams tanks, 270 M2 Bradley infantry fighting vehicles, 118 M2 armored reconnaissance vehicles, 168 M577 command-and-staff vehicles, 348 M113A1 armored personnel carriers, 60 M901 Tow self-propelled antitank rocket systems, 288 Dragon antitank rocket launcher systems, 66 106.7-mm self-propelled mortars, 18 Improved Chaparral antiaircraft missile systems, 36 Vulcan self-propelled antiaircraft guns, 75 Stinger antiaircraft missile systems (cruise), 146 helicopters including 50 AH-64A Apache helicopter gunships, and over 4,000 motor vehicles and more than 5,000 radio stations.

Footnotes

1. According to the latest reports in the foreign military press, 203.2-mm self-propelled howitzers have been removed from the artillery division together with administrative and service subunits.—Editor.

2. The personnel strength is to be reduced in the future to 16,000- 17,000 persons.—Editor.

11004

The Portuguese Brigade in NATO

18010337p Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian
No 3, Mar 88 (signed to press 5 Mar 88) pp 75-76

[Article by Col G. Ivanov]

[Text] The 1st Separate Motorized Infantry Brigade in the Portuguese ground troops (with a strength of 40,000 persons) has been given a special role by the command. In contrast to separate regiments within the composition of the four military districts and two military zones, the 1st Separate Motorized Infantry Brigade (headquartered in Santa Margarida) is subordinated directly to the main headquarters of the ground troops. It is the sole Portuguese troop formation allocated to the NATO combined armed forces in peacetime. In the estimation of the brigade commander, Brigade General K. Kuotu [transliteration], since January 1987 the brigade's combat readiness has satisfied the requirements of the military-political leadership of the North Atlantic bloc.

It is reported in the foreign press that the brigade contains: two motorized infantry battalions, a mechanized battalion (armed with M113 armored personnel carriers used as control vehicles, to convey personnel, to carry mortars and Tow antitank guided rockets, and as ambulances) and a tank battalion (M48A5 tanks); an artillery battalion containing three batteries of 105-mm towed howitzers (six each) and one battery of 155-mm self-propelled howitzers (six each); an antiaircraft battery; an engineer company (not yet fully outfitted with special equipment); support subunits. In accordance with the modernization plans, the brigade's motorization is to be completed, the firepower of its artillery subunits is to be increased, and air defense capabilities are to be reinforced in 1987-1991 (besides 20-mm guns, the antiaircraft battery is to be equipped with Blowpipe surface-to-air missiles).

In the event that the situation in Europe deteriorates, the brigade is to be moved to northern Italy and transferred to the commander-in-chief of the NATO combined armed forces in the South European theater of military operations. Its units and subunits are to be prepared for aggressive combat activities jointly with (or in the composition of) one of the army corps of the Italian ground troops. It is felt that in a time of a deteriorating situation, it may require up to 2 weeks to transfer the brigade to its operational destination in its full strength (together with combat equipment and motor transport resources). The 1st Separate Motorized Infantry Brigade is already participating in peacetime exercises within the composition of NATO combined armed forces, it regularly undergoes company and battalion tactical exercises, and not less than once a year an integrated readiness inspection of the brigade is organized by the main headquarters (see figure [not reproduced]).

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New EH-101 Multipurpose Helicopter

18010337q Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian
No 3, Mar 88 (signed to press 5 Mar 88) pp 76-77

[Article by Col V. Utkin]

[Text] It is reported in the foreign press that Great Britain and Italy are continuing their efforts to design the new EH-101 medium multipurpose helicopter. It is to be produced in three basic versions: antisubmarine (A), passenger (B) and troop-transport (C). In addition the helicopter may be used in search and rescue operations as well as for a number of other missions.

It is emphasized in the Western press that EH-101 helicopters of all modifications will have practically the same design, and they will be equipped with five-blade main and four-blade tail rotors. However, depending on the chief purpose of the helicopter, and correspondingly the composition of onboard equipment and the propulsion unit, some of the combat characteristics will differ somewhat (see table). The EH-101A (antisubmarine) helicopter will carry four Stingray torpedoes or 24 radiosonar buoys. It is to be equipped with radar and a lowering sonar station as well as other onboard special equipment required for its missions (for greater detail see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 7, 1987, pp 54-55.—Editor). In its passenger variant (EH-101B) the helicopter can carry up to 30 persons, while in its troop- carrying variant it can carry up to 28 armed soldiers or an equivalent weight of various cargo. The latter modification differs from the two previous ones in having a double door and a cargo ramp in the aft part of the cabin.

There are plans to build nine experimental models of the helicopter for comprehensive flight and ground tests. The first was built by England's Westland in April 1987 (see figure [not reproduced]). Its propulsion unit consists of three CT7-6 engines (with a maximum power of 2,000 horsepower per shaft) built by America's General Dynamics. Manufacture of the helicopters is to be organized at plants of England's Westland, mentioned above (in Yeovil) and Italy's Augusta.

According to preliminary data the British navy initially plans to purchase 50 EH-101A helicopters, while the Italian navy will purchase 38. The English air forces also intend to order 25 EH-101Cs. Canada is showing considerable interest in the new helicopter (its military leadership is considering the question of purchasing 35-50 EH-101As), as are a number of other countries. In the estimation of representatives of the developing companies, the total orders for manufacture of EH-101 helicopters of all modifications may be around 800 units.

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(1) Характеристики	EH-101A	EH-101B	EH-101C
Масса вертолета, кг: (2)			
максимальная взлетная (3)	13 000	14 290	14 290
пустого (4)	7195	7315	7660
оборудованного (5)	9275	8500	8545
Максимальный запас топлива во внутренних баках, кг (6)	3450	3450	3450
Скорость полета, км/ч (7)			
максимально допустимая (8)	320	320	320
максимальная крейсерская (9)	296	296	296
нормальная крейсерская (10)	280	280	280
Перегоночная дальность полета, км (11)	1850	1850	1850
Размеры вертолета, м: (12)			
длина (с учетом вращающихся винтов) (13)	22,94	22,94	22,94
длина (винты сложены) (14)	15,85	—	15,85
ширина (винты сложены) (15)	5,49	—	5,49
высота (с учетом вращающихся винтов) (16)	6,50	6,50	6,50
высота (винты сложены) (17)	5,18	—	5,18
диаметр несущего винта (18)	18,59	18,59	18,59
диаметр хвостового винта (19)	4,01	4,01	4,01
Силовая установка: (20)			
количество х тип двигателей (21) / мощность двигателя, л. с. (22)	3 х ТВД (24) / 1700	3 х ТВД / 2000	3 х ТВД / 2000
Экипаж, человек (23)	4	2	2 - 3

Combat Characteristics of the Principal Modifications of the EH-101 Helicopter (Planned)

Key:
1. Characteristics
2. Helicopter weight, kg
3. Maximum take-off
4. Empty
5. Equipped
6. Maximum fuel capacity in internal tanks, kg
7. Speed, km/hr
8. Maximum permissible
9. Maximum cruising
10. Normal cruising
11. Ferrying range, km
12. Helicopter dimensions, m
13. Length (including rotating rotors)
14. Length (rotors folded)
15. Width (rotors folded)
16. Height (including rotating rotors)
17. Height (rotors folded)
18. Main rotor diameter
19. Tail rotor diameter
20. Propulsion unit
21. Number x type of engines
22. Horsepower
23. Crew
24. Turboprop engine

Articles in ZARUBEZHNOYE VOYENNOYE OBOZRENIYE Not Translated

18010337r Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian
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